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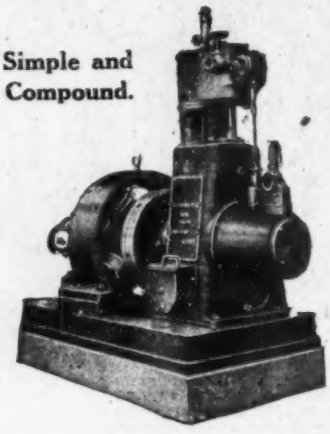

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ELECTRICAL REVIEW.

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AN ELECTRICAL REVIEW.

THE reading of the Presidential address before the Institution of Electrical Engineers is always a notable event in the electrical world; and that of Mr. Llewelyn Atkinson was no exception, though, as he suggested, there is a tendency nowadays to overestimate its importance. Mr. Atkinson possesses in high degree a well-ordered mind—a mental card-index, replete with references to everything electrical—and he is able, without effort or confusion of thought, to draw upon any compartment of that comprehensive store at pleasure, and to discuss any subject either cursorily or in minute detail, according to the needs of the moment. Thus he touched lightly upon telephony, mentioned relativity, and delivered an essay on agriculture which revealed an intimate acquaintance with its mysteries. So catholic are his interests, and so pregnant his remarks, that it is impossible for us here to refer to more than a fraction of the topics dealt with in his address, in which he reviewed the progress made in the electrical industry during the past half-century.

One point relating to the office which he fills is deserving of special attention on the part of the Institution—namely, the excessive burden imposed upon the President by his multifarious duties, which, as Mr. Atkinson observed, practically absorb the whole of his time during his period of office. From this two undesirable results ensue: that those who consent to occupy the post are seriously overworked, and that many of the most eminent members are debarred from accepting the honour on account of the exorbitant demand upon their time. That steps should be taken to remove these disadvantages cannot be denied, and we venture to suggest that the situation might be met effectively by deputing a considerable proportion of the duties of the President to the Vice-Presidents, who at present have little scope for their energies. This course would not only relieve the pressure on the President, but would also enhance the dignity and responsibility of the Vice-Presidents. We are not in a position to elaborate the suggestion by entering into details, but we see no reason why this rather obvious plan should not be found to afford a satisfactory solution to a very real and pressing problem.

Referring to the development and extension of the activities of the Institution during recent years, to which Dr. Ferranti gave the initial impulse, the President justified it in the light of the circumstances peculiar to the electrical industry. He might have justified it also on the ground that it had proved successful in raising the prestige, and, consequently, increasing the membership of the Institution, which is now the largest and most active society of its kind in this country. As Mr. Atkinson pointed out, it is also the most useful to its members, and in the future, we have no doubt, it will increase its lead in that direction. Incidentally, it is embarrassed by its own endeavours, and before our next issue appears the members will be called upon to decide whether they are willing to pay for the privileges which they enjoy. Seeing that the cost of other services has generally doubled, whilst the I.E.E. subscriptions have remained unchanged since 1912, we anticipate that the necessity of the moderate advance proposed by the Council will be readily recognised by the members. In our "Institution Notes" we give particulars of the much greater increments proposed by the Institution of Civil Engineers. By the system of proxy voting every member can now take part in the decision, and in the interests both of the Institution and of the industry to which they belong, we trust that they will honour the call of the Council.

It is interesting to note that cables for 50,000 volts can be obtained from manufacturers. The investigations that

cable-makers are known to be carrying on in this direction have been kept very secluded, and it was not generally known that such cables had yet advanced beyond the experimental stage. There is a certain fascination in the proposition to imprison conductors at a potential difference of 50,000, or even, as the President hinted, 100,000 volts, within a fraction of an inch of one another, over a length of 30 or 40 miles, with confidence in their fulfilling their purpose for as many years. That this feat will be successfully achieved, however, we have no doubt, although there are great difficulties to be overcome; seeing that insulating paper is at present stressed only to one-tenth of its ultimate dielectric strength, it is obvious that there is an ample margin to work upon.

We are glad to see that Mr. Atkinson lays stress upon the very grave industrial problems with which the whole country is faced, and the serious threat that they offer to its future prosperity, though we are unable to agree with his diagnosis of the disease from which they spring. He considers that the symptoms point to a general dislike of work, due to its monotony under modern conditions; we venture to question that conclusion, and to suggest that there is very little evidence to support it. Mr. Atkinson, at the last informal meeting, referred to the Ford car factory as touching the limit of specialisation in repetition work; but are the employés of the firm discontented? On the contrary, we have always understood that they were exceptionally content and very highly paid, and that employment in those works—whether in the United States or in this country—was eagerly sought for. Again, in the textile industries, for example, much of the work appears to be exceedingly monotonous; it has been done on the same lines, more or less, for generations—but the textile operatives are amongst the quietest workers, and get on very well with their employers, not a few of whom spring from the same class. Nor are the engineering industries, as a whole, markedly averse to repetition work or piece work. On the other hand, a coal miner's work is comparatively varied owing to the constant change in the conditions of his working place, and he is exceptionally well paid—yet, would anyone call him contented? Similarly, agricultural work, in which Mr. Atkinson is so keenly interested, involves a continual change of duties, from day to day and from season to season—why, then, is it so difficult to keep labour from deserting the fields and crowding to the towns? Formerly low wages could be blamed, but with the higher wages now obtaining labour is still very scarce. The late Prof. Münsterberg, in his book on "Psychology and Industrial Efficiency," challenges the popular view on the monotony of repetition work, and cites examples of his investigations into this very question, which tend to show that the supposed victims of monotonous tasks vigorously dispute the lack of variety and interest in their work.

No! The real root cause of the industrial unrest, in our opinion, is the workman's feeling that, no matter how long or how hard he works, he is a mere tool for the enrichment of his employer, with no prospect of securing a share in the business in which he has invested his labour; and he is determined that in future that state of things shall cease. That is why the sober element demand a share in the control of the business—and in the profits; while the extremists clamour for the more violent course of confiscation, or, what is little different, nationalisation of industries. *They will not go on working to enrich the boss.*

The justice of that view has been admitted by many of our leaders of industry, including Mr. Atkinson in his address, and we are pleased to see that he sets a limit to the "rent" of capital, beyond which the surplus would be shared between the managing and the operative workers.

Grants to Aid Research.

An interesting case, of which an account is given in our "Legal" columns, has just been settled by Mr. Justice Eve. It concerned the right of a manufacturing company to devote a portion of its surplus funds to the furtherance of scientific education and research, on the ground that that allocation was conducive to the welfare of the company, although it was not applied to a specific object. We are glad to record that the decision was in favour of the action of the directors. Had it been otherwise, it would have been difficult, if not impossible, for manufacturers to assist in providing for the scientific training of the men whose services, as managers and investigators, are essential to the development of British industries. As we have pointed out, unless the manufacturers give attention to this subject, and help to furnish the necessary funds, they will only have themselves to blame for a shortage of scientific staffs, which is, indeed, already making itself felt.

An Unfortunate Coincidence?

We learn that early this week a number of members of the Electrical Power Engineers' Association, who are also members of one of the leading scientific institutions, have received from it forms inquiring whether they are willing in case of emergency to serve in power stations. Clearly these forms are being sent broadcast to the members of that institution.

Now, it is well to prepare for emergencies—in advance; but when, as it appears to these members of the E.P.E.A., a mean advantage is taken of the additional fortnight's grace (which they conceded on the request of the Joint Board for the purpose of negotiation) to take measures for their defeat, the circumstances inevitably suggest to them that treachery is afoot. Their reply to that may not unnaturally be a rescission of the fortnight's extension, in which event the matter will come to a head within a few days. Doubtless there is no insidious meaning attaching to the said circulars, but nevertheless the consequences of this ill-advised action may be serious—and sudden. It is of the first importance that no interruption of supply shall occur, and we most earnestly hope that no action will be taken which tends to precipitate that disastrous event.

German Reconstruction.

An engineer who has recently had ample opportunity of thoroughly studying the situation in Germany writes as follows:—A recent visit to Berlin and other parts of Germany conclusively demonstrates that the captains of industry and the working people are all putting their backs into production, and that they realise that by that means alone can their conditions of living be improved. Although in some of the big works a 46½-hour week has been introduced, the skilled labourer is producing more now in 46½ hours than he did before the war in 54 hours. The miners and the iron and steel workers are prepared, if the necessity is shown them, to work 10 and more hours a day without asking for higher rates, and their output is rapidly increasing.

Law and order prevail, and railways are operated as punctually as before the war, although lower speeds are adopted and fewer trains are run, resulting in overcrowding.

Wages have, of course, risen; workmen to-day get 8 to 10 times the pre-war rates, which, at the present rate of exchange, are equivalent to between one-third and one-half of the rates previously ruling in this country. The technical staff has had nothing like such increases, and whilst highly trained is costing one-third or less what it costs in this country.

All the large industries, such as electrical works, locomotive and wagon works, steel works, &c., are full of work, and have heavy and pressing orders, including large orders from England, France, Belgium, and South America.

Even with the help of anti-dumping laws and with the protection of key industries, the situation from our point of view is very serious unless our people realise that our future, nay, our very existence, depends upon increased output per man and economy in production.

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(*Concluded from page* 646.)

Wet air filters and fans of Messrs. Heenan & Froude's manufacture are provided to ensure efficient ventilation of the machines. They are two in number, and have a capacity of 20,000 cb. ft. of air per minute; each filter with its fan is driven by a 25-H.P. 220-volt motor. Owing to the low speed of the mill motor the provision of forced ventilation is essential for the satisfactory running of the machine. The machines comprising the fly-wheel set, however, in view of their higher speed, are self-ventilating, but on account of the large amount of dust which is always present in rolling mills, the second filter equipment was installed to ensure a supply of clean air for the machines, thus preventing the possibility of the windings becoming choked with dirt. Further, the second filter forms a convenient stand-by for the mill motor, and arrangements are made so that in the event of failure of one filter, that which usually supplies the fly-wheel set can take over the duty, the fly-wheel set running in the meantime without forced ventilation.

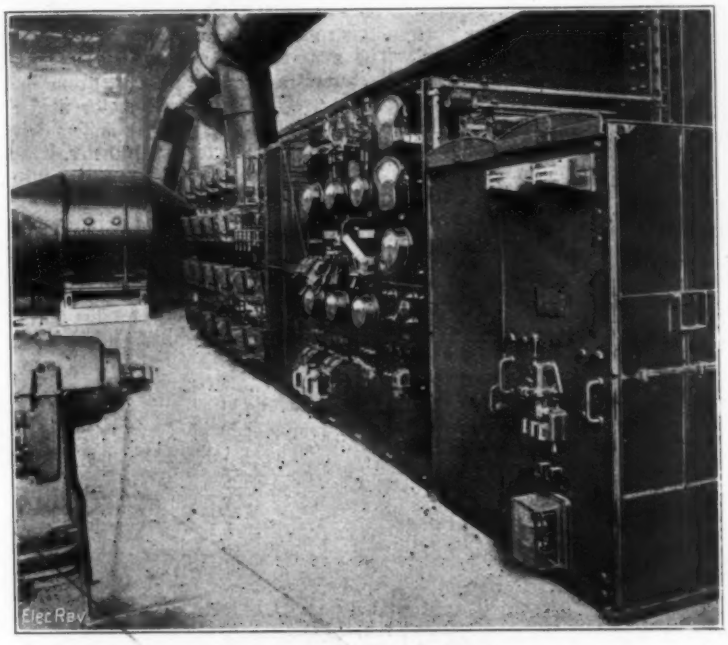


FIG. 8.—COGGING MILL SWITCHGEAR; WET AIR FILTERS IN BACKGROUND.

Fig. 8 shows the switchgear for this equipment. The 6,300-volt truck type switchgear for controlling the 3,000-H.P. induction motor is shown on the right, the D.C. switchgear in the centre, and a combined starting and slip-regulating panel on the left. The wet air filters also appear in the background of this illustration. A closer view of the starting and slip-regulating panel is shown in fig. 9, from which the arrangement of the gear can be clearly seen. The panel is of the contactor type, and is connected to banks of metallic resistance in a basement. Whilst starting the current taken by the motor is automatically kept within predetermined limits by means of current-limiting relays. When rolling is in progress an overload on the induction motor causes certain of the contactors to come under the control of the special high-speed relay shown at the top of the panel on the right-hand side. This relay opens

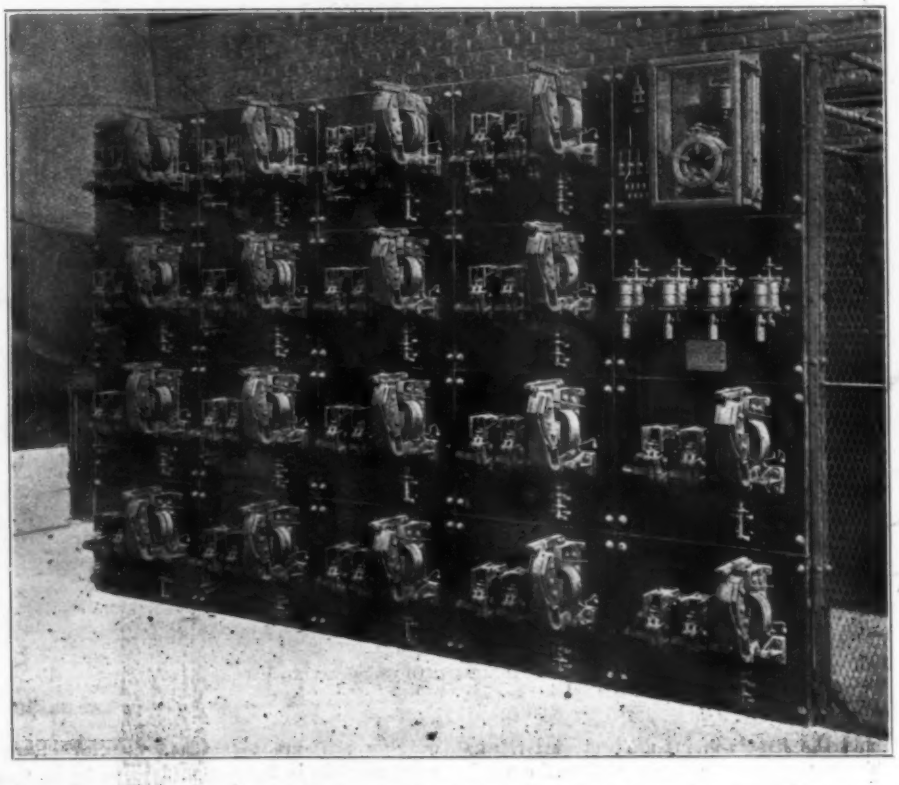


FIG. 9.—AUTOMATIC STARTING AND SLIP-REGULATING PANEL FOR FLYWHEEL SET.

the regulating contactors in succession, thus inserting resistance in the rotor circuit of the induction motor, the actual number of contactors opened, and hence the amount of resistance inserted, depending upon the magnitude and duration of the overload. This causes the motor speed

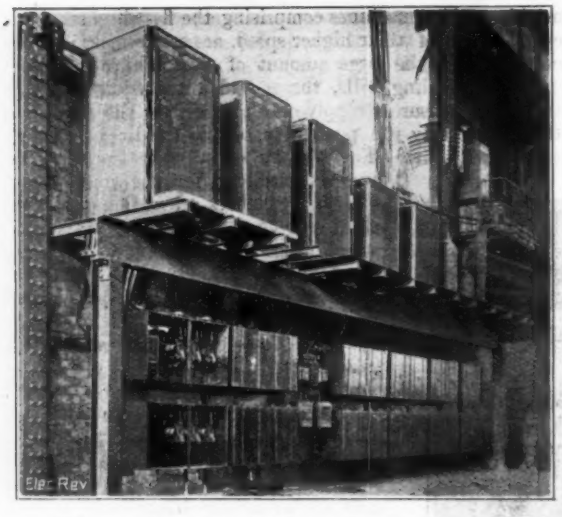


Fig. 10.—Contactor Gear for Mill Motor and Auxiliaries.

to fall, allowing the fly-wheels to assist in driving the generators.

The action of the relay is extremely rapid, and both the induction motor and the supply mains are protected from overloads, even when the peak loads on the mill motor build up very rapidly. Further, no time is lost in accelerating the fly-wheels to full speed again after the peak load in preparation for the next pass. To prevent the drop in speed of the fly-wheel set being transmitted to the mill, the regulating contactors are so arranged as to automatically cut out resistance from the exciter field when inserting resistance into the rotor circuit of the induction motor. This resistance is so adjusted as to maintain a constant voltage across the armature of the mill motor independent of the speed of the fly-wheel set.

The whole of the auxiliaries for this mill are driven by means of B.T.H. 220-volt D.C. motors. They include a 40-H.P. motor for the special ingot chariot, two 100-H.P. motors for the live rolls, a 60-H.P. motor for the screw-down, and a 25-H.P. motor for the manipulator. In the case of the live rolls two spare motors are installed alongside the main motors so as to cut out delays in the event of a breakdown. The motors are all controlled by contactor gear, which is illustrated in fig. 10. Reading from left to right, there are shown :—The double mill motor field contactor panel ; two small control panels for the motors driving the pinion oil pumps ; two panels for the 100-H.P. live roll motors ; a 60-H.P. panel for the screwdown, and a 25-H.P. panel for the manipulator.

The above equipment was designed for a maximum output of 100 tons per hour when cogging down from three-ton ingots having a mean section of 19 sq. in. to billets of 6 sq. in., but this output has been considerably exceeded on one or two occasions. Two sets of shears are installed between the cogging mill and the billet and slab mills ; they are of Messrs. Davy Bros.' construction, and each set is driven by a 200-H.P. B.T.H. motor.

Billet Mill Equipment.—The billet mill is of the Morgan type, and consists of four stands of 21-in. rolls and six stands of 18-in. rolls. The 6-in. sq. blooms from the cogging mill are reduced to 4-in. sq. billets in the 21-in. rolls, and can be further reduced to 1¾ in. sq. in the 18-in. rolls if desired.

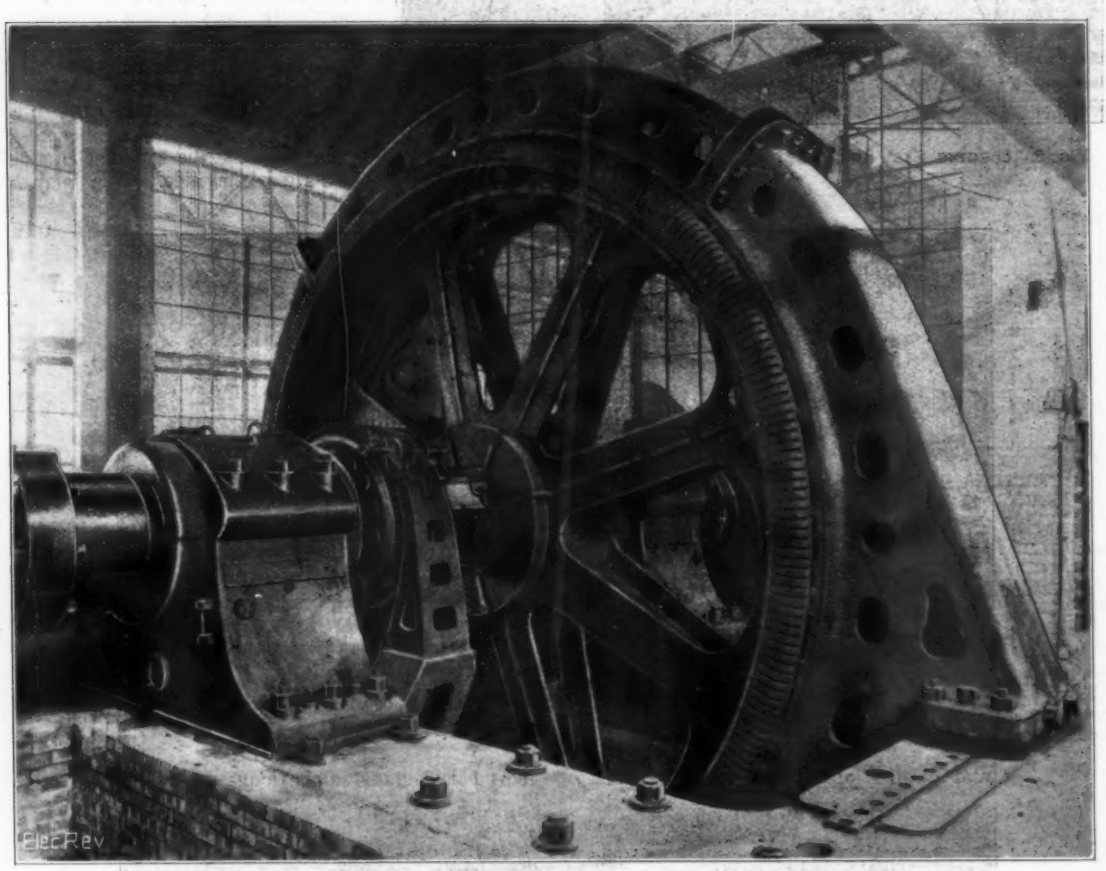


Fig. 11.—A 5,000-10,000-H.P. Induction Motor Driving Billet Mills.

The motor driving this mill is a 6,300-volt, 50-cycle three-phase B.T.H. slip-ring type induction motor having a normal rating of 5,000 H.P. and a peak rating of 10,000 H.P. The motor runs at 92 R.P.M., and is coupled on either side to a long shaft driving the various stands of rolls through bevel gearing. The machine is shown in fig. 11. The motor is controlled by means of the special contactor panel shown in fig. 12. A change-over switch is provided on this panel to enable the motor to be started either automatically, or under hand-control, by means of a master controller. Two stator switches are provided, one for forward and one for reverse rotation, the two switches being mechanically interlocked to prevent both being closed together. The object of this arrangement is to enable a stalled billet to be backed out from the rolls, the arrangement of the control gear being such as to allow the motor to exert twice full-load torque at starting when running reversed under hand-control.

The 1¾-in. billets from the 18-in. rolls are cut into 30-ft. lengths by steam-driven flying shears, and pass thence to the skew assembly table, which is operated by a 40-H.P. B.T.H. motor. A run-through, also driven by a 40-H.P. motor,

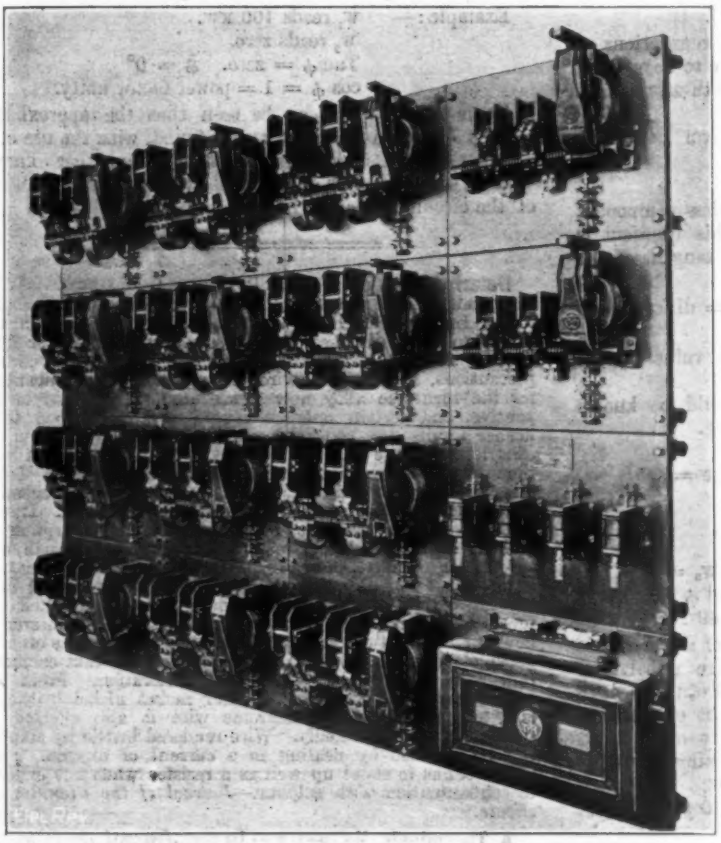


FIG. 12.—CONTACTOR PANEL FOR BILLET MILL MOTOR.

transfers the billets to the cooling bank, where a set of jobbing shears, driven by a 75-H.P. B.T.H. motor, is installed for cutting them to suitable lengths for stock if required.

Slab Mill Equipment.—This is at present under construction. It will consist of two stands of 21-in. rolls, and will be driven by a 1,200-H.P., 6,300-volt, three-phase, 50-cycle, B.T.H. slip-ring type induction motor. This motor will be started by means of contactor gear, and, as as in the case of the billet-mill motor, both forward and reverse stator switches will be provided, but no provision for hand-control is to be made in this instance. When rolling slabs, the cogged blooms are skidded across from the outgoing roller table of the cogging mill to the slab shears, which have already been referred to, and after cropping the ends, they are passed on to the 21-in. slab mill. The conveyor which removes the crop-ends from the shears is driven by a 25-H.P. B.T.H. motor.

THE MEASUREMENT OF POWER FACTOR.

BY D. SCLAR.

I HAVE read with considerable interest the discussion on power factor which has been taking place in the columns of the ELECTRICAL REVIEW, and I wonder how many engineers know the power factors of the systems they are interested in; I am sure the figures would indeed surprise them.

I know of a works where a 75-K.V.A. transformer was installed to take the load of three induction motors whose rated H.P. was equal to 100. However, these motors were very much underloaded, their total load only amounting to 22 H.P., at a power factor of 30 per cent. The transformer was therefore loaded to 55 K.V.A., although the meters connected in the circuit only registered 16·5 KW. The wattless component of the power can for this case be shown to equal 52·5 K.V.A.

I should, therefore, like to mention some methods of measuring the power factor of a circuit where a power-factor indicator is not available.

The most common method is by the use of an ammeter, voltmeter, and wattmeter. The current and voltage of the circuit are measured, the product of these two giving the apparent watts of the circuit when the supply is single-phase. However, the wattmeter gives the true watts of the circuit. The power factor is then the ratio of true watts to the apparent watts, the true watts and apparent watts being equal at unity power factor.

For a two-phase load the current, voltage, and the watts of each phase should be taken, thus enabling the power factor of each phase to be obtained.

For a three-phase circuit the power factor is given by the ratio of the true watts to root-three times the product of line current and line voltage.

The three-ammeter and three-voltmeter methods of obtaining power factor can be resorted to where a watt-meter is not at hand; but neither of these methods is of much practical use on three-phase circuits.

On a load being supplied from one phase and neutral of a three-phase circuit, the power factor can be obtained with the aid of a wattmeter only, no ammeter or voltmeter being necessary.

First, the power of the circuit is measured by a wattmeter in the usual way; say, this is equal to W_1. The volt coil of the wattmeter is then connected across the remaining two lines, this reading giving, say, W_2; W_2 must now be divided by $\sqrt{3}$, which gives a quotient equal to, say, W_{21}.

The tangent of the angle of phase difference between the voltage and the current in the circuit is then given by the ratio of W_{21} to W_1, *i.e.*—

$$\text{Tan } \phi = W_{21}/W_1$$

The cosine of ϕ gives the power factor of the circuit. If W_2 should be a negative reading, the leads of the volt coil of the wattmeter should be reversed, so as to make the reading positive. Before using the above method, it should be known whether the power factor is leading or lagging.

The proof of this method is as follows:—

W_1 reads $ec \cos \phi$.

W_2 reads $\sqrt{3}\, ec \cos (90° - \phi)$ ($\cos \phi$ leading

or $\sqrt{3}\, ec \cos (90° + \phi)$ or lagging).

$\therefore$ W_2 reads $\sqrt{3}\, ec \sin \phi$ (neglecting sign).

$\therefore$ W_{21} reads $\sqrt{3}\, ec \sin \phi / \sqrt{3} = ec \sin \phi$.

$\therefore$ $W_{21}/W_1 = ec \sin \phi / ec \cos \phi = \tan \phi$.

$ec \sin \phi$ is the wattless component of the power in the circuit.

Wattless component/energy component = tan ϕ.

Example :—Power in circuit = 100 KW. = reading of meter $W_1 = ec \cos \phi$.

Reading of W_2 = 300 KW. = $\sqrt{3}\, ec \sin \phi$.

Then $W_2 = 300\sqrt{3} = 173$ KW.

Then $\tan \phi = 173/100 = 3/\sqrt{3}$, and $\phi = 60°$.

Cos 60° = 0·5 ; power factor of circuit = 0·5.

If the volt coil of the wattmeter be only able to stand up to the phase pressure, and not the line pressure of the system, then the above method of finding the power factor may be adopted with a slight modification.

The power of the circuit is measured as before, and, as before, call this $W_1 = ec \cos \phi$.

Two other readings, W_2 and W_3, are taken.

These readings are obtained by now connecting in turn the end of the volt coil of the wattmeter to each of the other two lines not already connected to the wattmeter, care being taken that the remaining end of the shunt coil is still connected to the neutral point. This precaution ensures that the current in the volt-coil of the wattmeter is in the same direction as in W_1.

Then—W_1 reads $ec \cos \phi$.

W_2 reads $ec \cos (120° - \phi)$.

W_3 reads $ec \cos (120° + \phi)$.

Should W_2 or W_3 be a negative value, the connections of the voltmeter coil of the wattmeter will have to be reversed so as to obtain a reading on the meter, but these readings must be considered as negative.

The difference of readings W_2 and W_3 can be shown to be—

$$= \sqrt{3}\, ec \sin \phi.$$

This value divided by $\sqrt{3}$ gives the wattless component of the power of the circuit, and when this quotient is divided by the power of the circuit W_1 the tangent of the angle of phase difference is obtained—

i.e., $\tan \phi = ec \sin \phi / ec \cos \phi$ = difference of W_2 and $W_3/\sqrt{3} \times W_1$.

The power factor is then given by the value of the cosine of the angle ϕ.

In this method, as in the former, it should be known whether the power-factor is leading or lagging.

Example :—

Say the same power factor as in the last case = 0·5.

W_1 reads, say, 100 KW.

W_2 reads ,, + 100 KW.

W_3 reads ,, − 200 KW.

Difference between W_2 and W_3 = 300.

$\tan \phi = 300/\sqrt{3} \times 100 = \sqrt{3}$, and $\phi = 60°$.

Power factor of 0·5 = cosine of 60°.

In a three-phase circuit where the power of the circuit is being measured by a three-phase three-wire unbalanced meter working on the two-wattmeter method of three-phase power measurement, the power factor can be obtained by reading the wattmeter with either of the two elements working separately. This is effected by breaking the shunt coil of one element, say, reading equal to W_1. The total power, measured by both elements working together, must also be measured.

Say the total power is equal to W_3.

Then $\tan \phi = (2W_1 - W_3)\sqrt{3}/W_3$.

Cosine ϕ is then the power factor,

or $\tan \phi/\sqrt{3} = (W_1 + W_1 - W_3)/W_3 = (W_1 - W_2)/(W_1 + W_2)$.

$W_1 - W_2$ is the difference of the readings of the two elements, whilst $W_1 + W_2$ is the sum of the two readings, equal to the total power. It is well known that the sum of the two readings is equal to $\sqrt{3}\, ec \cos \phi$°, and that the difference of the two readings is equal to $ec \sin \phi$. Now, the wattless component of the power in a three-phase circuit is equal to $\sqrt{3}\, ec \sin \phi$. If, therefore, we multiply the difference of the readings by $\sqrt{3}$ we obtain the wattless component of the power.

$$\frac{\text{Wattless component of power}}{\text{Energy component of power}} = \frac{\sqrt{3}\, ec \sin \phi}{\sqrt{3}\, ec \cos \phi}$$

$$= \sqrt{3}\,(W_1 - W_2)/(W_1 + W_2) = \tan \phi.$$

Example—

Total power of the circuit = 60 KW.

W_1 reads 40 KW. ; W_2 reads 20 KW.

$\tan \phi = \sqrt{3}\,(W_1 - W_2)/(W_1 + W_2) = 20 \times \sqrt{3}/60 = 1/\sqrt{3}$.

Angle whose tangent equals $1/\sqrt{3} = 30°$.

Cosine 30° = 0·866 = power factor.

In a two-phase circuit where the power factor is required and there is only a single-phase wattmeter available, the following method can be adopted :—

The wattmeter is connected up so as to read the power of one phase, say, equal to W_1.

The volt-coil of the wattmeter is then connected so as to read positively across the other phase ; take this reading to be equal to W_2. Then—

W_1 reads $ec \cos \phi$,

W_2 reads $ec \cos (90° \pm \phi)$,

$\therefore$ W_2 reads $ec \sin \phi$,

which is the wattless component of the power in the circuit. The tangent of the angle of phase difference is now given by the ratio of W_2 to W_1.

$$\tan \phi = W_2/W_1.$$

The cosine of ϕ is the required power factor of the phase under test. The other phase may be done in the same manner if the power factors of both phases are not alike.

Example :— W_1 reads 100 KW.

W_2 reads zero.

Tan ϕ = zero. $\phi = 0°$

cos ϕ = 1 = power factor unity.

From the above it can be seen that the approximate power factor of any circuit can be found, with the use of a wattmeter only, by the introduction of another known voltage, the phase angle between this voltage and the voltage of the circuit under test being known.

Deterioration of Nickel Resisters.—Messrs. F. A. J. Fitzgerald and Grant C. Moyer, of the Fitzgerald Laboratories, Inc., presented at the thirty-eighth meeting of the American Electrochemical Society (Cleveland, September 30th-October 2nd) a communication showing that, under certain precautions, pure nickel wire is applicable as a substitute for the nichrome alloy now much used. This alloy is expensive, and certain onerous conditions are attached to a licence for its use. Nickel has a high thermal coefficient of electric resistance and a liability to oxidation, but it was thought that these disadvantages could be overcome. Tests, however, showed early deterioration, by the wire becoming brittle, although no marked oxidation had occurred. It was thought at first that the result was due to absorption of carbon, as the insulating material was infusorial earth and a refractory cement, both of which contained organic matter. Some of the brittle wire was tested by being heated in a current of oxygen, and it was found that the emitted gas produced a precipitate of barium carbonate. The inference, however, was not correct, and details are given in the original paper of experiments by which it was proved that combination with suplur is the cause of deterioration. From the experiments it appears that sulphur makes nickel brittle at low temperatures; and nichrome wire is also affected by sulphur, but less markedly. Wire rendered brittle by sulphur can be softened by heating in a current of oxygen. Pure nickel seems to stand up well as a resister when not exposed to contamination with sulphur.—*Journal of the Franklin Institute.*

A Thermionic Voltmeter.—In the *Journal de Physique* for August last MM. H. Abraham, E. Bloch, and L. Bloch describe their direct-reading thermionic voltmeter which is manufactured by Carpentier. The invention of this instrument is a notable step in the development of the science of electrical measurement. Hitherto it has been impossible to get a direct-reading voltmeter which would read one volt of alternating pressure accurately. This instrument gives a direct reading for the ten-millionth part of an alternating volt. It consists of two thermionic amplifiers, followed by two thermionic valves in parallel, the "plate" current of which is measured by an ordinary direct-current milliammeter. With the help of this instrument the measurement of very minute alternating currents and pressures is as simple as everyday measurements with ordinary voltmeters and ammeters. By its use absolute measurements of inductances and capacities are made in a few minutes with a maximum inaccuracy of about 1 in 1,000. By the use of suitable electrical "filters" approximately sine-shaped waves are obtained by blocking out the disturbing harmonics. The authors have shown recently in the same journal how the frequency of an alternating current can be determined with high accuracy. Its sensitiveness is shown by the fact that it can measure, by means of a direct reading of the pointer, the capacity of a sphere one millimetre in radius. The instrument has very many useful applications.—*Nature.*

THE CROWN-MAGNETIC MOTOR CAR.

The Entz Petrol-Electric Transmission.

By F. H. HUTTON.

An exhibit of outstanding interest at the recent Motor Exhibition was to be seen at the White City, and consisted of two complete Crown-Magnetic cars.* It was to be regretted that both the cars were shown complete, since a chassis without a body would have demonstrated to the public that here, at last, was a radical departure from the conventional system, which it is to be feared was not apparent to a very large number of spectators who judge mainly by external appearances. However that may be, there is no doubt that some change in the transmission system of motor cars is long overdue, the wonder is that the prevailing system of sliding gear-wheels into mesh has survived so long. The only merits of the standard system are that it provides a direct drive on top gear, and that as regards maintenance and upkeep it is comparatively "fool-proof"; that ugly, but expressive, word by no means applies to its operation, for a high degree of skill is necessary to ensure "clean" changes of gear under all circumstances, "double-declutching" being essential in the majority of cases.

Many different systems have been put forward for transmitting the power from the engine to the road wheels of a car so as to overcome the inherent disability of an internal-combustion engine with regard to torque at low speeds, but none have met with any great success or general adoption. Among such systems are friction drives, with one disk sliding across the face of the other, which, although convenient for small cars, do not seem likely to find a place on the larger ones, and suffer from the defect of having no direct drive.

Hydraulic transmission, generally using oil as the medium, is, of course, well known, and gives very beautiful results on such comparatively heavy and slow-moving mechanisms as machine tools, capstans, hoists, cranes, presses, ship's steering gear, &c. Older motorists will perhaps remember the Pittler rotary machine, which was exhibited in London several years ago as the transmission of a car, and which seemed at the time very promising.

One of the latest hydraulic transmission systems is the Williams-Janney variable speed gear, consisting of a special type of pump with a variable stroke delivering fluid to a motor of similar type, but with a fixed stroke, the speed of the motor depending on the quantity of fluid delivered by the pump. In this way the speed of the motor can be varied by infinite degrees from maximum to zero without steps, and in either direction; moreover, a straight-through direct drive can be provided on top speed. Hydraulic transmission systems, however successful for other purposes, do not seem to lend themselves for automobile work where they are required to transmit the power from the high-speed engine on a car; the first cost is excessive; very high fluid pressures are required, in order to keep down the weight and size of the apparatus, with the consequence that there is a considerable danger of leakage at valves, joints, pistons, &c., and the fluid is liable to become frothy and heated when in constant circulation at high speed.

It is to electric transmission that we look forward most confidently for the solution of the problem on automobiles.

The most obvious form of electric transmission is that in which the engine drives an ordinary dynamo direct, the current being taken to one or more motors driving the rear wheels. The Stevens system which has been used successfully for many years on Tilling-Stevens omnibuses is the most widely known application of this kind; both the armature and the field have double windings which are connected up in series or in parallel according to conditions of load and gradient. Other systems have been introduced, one or two including a direct drive on top speed, others having a battery as a necessary component of the transmission system, but none of them have achieved any great measure of success. No system involving the use of a battery as an essential element is likely to come into general use for the particular purpose under consideration.

At this juncture, therefore, the appearance of the Entz transmission system in this country on the Crown-Magnetic car is of exceptional interest. Consisting essentially of only two dynamo-electric machines, giving a direct drive on top speed through the medium of a magnetic clutch; providing, with the addition of a small battery, a lighting system, an engine starter, and an auxiliary brake; requiring very much less skill in manipulation than the ordinary mechanical gear; and being equally silent at all speeds, it certainly holds out much promise providing that its manufacturing cost and the weight can be kept within necessary limits. Before proceeding further it may be stated that the system has been in use in America for several years on a car called the Owen Magnetic with very successful results; but for the war it would, no doubt, have developed rapidly in that country where electrical devices are more quickly adopted by the general public than is the case over here. At the present time Owen Magnetic cars are being turned out in America as fast as manufacturing facilities permit.

The Entz transmission system installed in the Crown Magnetic cars which are imported into this country is as follows:—

General Arrangement.—The transmission consists of two series-wound machines occupying approximately the position of the usual clutch, clutch-shaft, and gear-box; the two machines with their resistance coils and controller constitute the whole of the essential mechanism. A small battery is carried for engine starting and lighting purposes, and also to give momentary assistance in exciting the field of the generator and so cause a quicker "pick up," but it is not *essential* to the transmission system; that is to say, the car can be run quite well without it, the engine being started by hand; in practice little difference is noticed in running the car whether the battery is in use or not. The two dynamo machines are arranged as follows: The forward machine occupies the position of the clutch on an ordinary car, its field magnets being directly connected to the engine, taking the place of the ordinary flywheel which is thus abolished; the field, therefore, always runs at engine speed. The armature is mounted on a large hollow shaft forming an extension of the propeller shaft. This machine is best described as a "clutch-generator" since it acts in both those capacities as required, and only as a motor when starting the engine; in the diagrams it is marked G. It should be noticed that both the field and armature of this machine revolve, the amount of current generated depending on the difference between their respective speeds.

The rear machine is situated a little further back, about the place usually occupied by the gear-box. The field of this machine is stationary, being attached to an aluminium cradle supported from the frame. The armature is mounted on the same hollow shaft as the armature of the other machine, so that under all circumstances both armatures run at the same speed, which is also propeller-shaft speed. The rear machine is called the motor M, since its chief function is that of a motor, taking current produced by the clutch-generator, to assist in driving the propeller shaft and boost the effort of the engine power transmitted by magnetic attraction through the clutch-generator. On the "high-speed

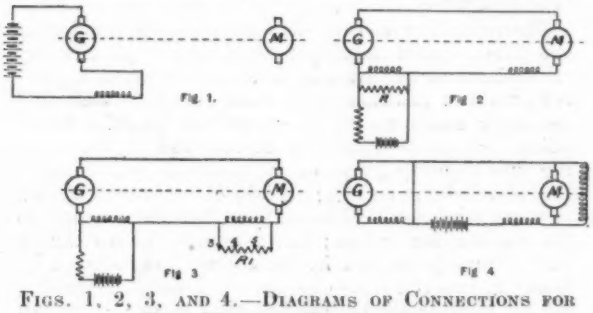
* Elec. Rev., Nov. 12th, 1920, p. 617; and Dec. 26th, 1919, p. 807.

position" this motor is used as a generator for charging the battery, and on the "neutral position" with the car running at a speed of over 15 miles per hour, as a generator for braking purposes.

The Action.—We will now consider the working of the system with reference to the diagrams, which, for the sake of simplicity, show only those connections in actual use in each position.

In the first place it must be understood that the energy from the engine is transmitted in two portions; one portion is mechanical energy transmitted direct to the propeller shaft through the medium of the magnetic clutch; the other portion is electrical energy generated by the forward machine owing to the "slip" or difference in speed between armature and field, and is used by the rear machine as a motor in assisting to drive the shaft. The proportion of each portion of energy transmitted depends on the position of the controller, the acceleration being caused by a variation in the proportion of energy transmitted by the two methods. On the high or ordinary running position all the energy is transmitted through the clutch-generator, this machine being short-circuited, and only a very slight amount of "slip" taking place to generate the energy required to produce the clutch action, the difference in speed necessary being given as about 2 per cent. The motor in this position takes no part in the transmission, but acts as a generator for battery charging. This is the normal state of affairs for ordinary running, and the speed of the car can be governed within the usual range by means of an ordinary accelerator pedal operating the throttle valve of the engine.

We will now consider the opposite end of the scale. Fig. 1 shows the engine cranking and the generator G acting as a series motor, the motor M being out of action. In the first position, fig. 2, the generator is run with a weak field owing to the shunt R, a non-inductive resistance, being placed across it in parallel. The



FIGS. 1, 2, 3, AND 4.—DIAGRAMS OF CONNECTIONS FOR ENTZ MAGNETIC TRANSMISSION.

current is led to the motor, and the circuits are being prepared for the next position; the car may be started and run slowly by accelerating the engine. The battery circuit is used for initial excitation only, and is cut out by a relay (not shown), when the main current builds up. This battery circuit is used in all the intermediate positions 1 to 5. The connections for the second position are the same as for the first, except that the shunt resistance R, weakening the generator field, is eliminated. The magnetic clutching effect and consequently the car speed is increased, less "slip" taking place. The connections for the third, fourth, and fifth positions, fig. 3, differ from those for the second position only in that a shunt resistance R_1 is used to weaken the motor M field; the amount of resistance in the shunt is varied for each of the positions, decreasing to give higher car speeds. Through the successive positions the magnetic clutch tightens up, causing the armature to revolve more nearly at the engine speed, and thus allowing the engine to transmit more of its power direct, and, therefore, the car speed to increase. The next step gives the high-speed position, fig. 4, for normal running, as already described. In this position the generator is short circuited, and the battery is charged by the motor M, which acts as a compound differentially-wound dynamo.

The above-mentioned positions of the controller form the main principle of the transmission, but two other steps are also provided. One, in which the forward machine acts as a dynamo, when the car is stationary, for charging the battery on special occasions as when a boost is required. The field magnets revolve round the armature which is then stationary, giving the output required at a very low speed. The other position referred to is provided to form an electric brake by the motor M acting as a series-wound dynamo, and delivering current to the resistance R. In this case the car is driving the armature, and the braking effect can be regulated by the amount of resistance in circuit.

As arranged on the Crown Magnetic car the Entz transmission system is not made reversible, the idea being that the result achieved would not compensate for the complication necessary in the controlling gear. Instead, a small supplementary gear-box of the ordinary type is used between the dynamo machines and the driving shaft, giving one reverse and one forward speed in addition to a straight-through direct drive ordinarily in use. The one forward speed is provided to allow a still further reduction for exceptional circumstances such as getting out of a ditch or very deep sand, &c., where otherwise a tow rope would be required; in ordinary running it would never be used.

From the foregoing account it will be seen that the system provides for an efficient transmission, direct on top gear; for several intermediate positions all equally silent; for a very effective starter; for battery charging either when the car is running or stationary; and for an electric brake, while the control is far and away more simple to operate than the conventional system now in use.

CORRESPONDENCE.

Letters received by us after 5 P.M. on TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

An Electric Lawn Mower.

Could you or any of your readers inform me who are the makers of an electrically-driven lawn mower? We have had repeated inquiries for this article from large country houses.

A. E. Saville.

Farnham Gas & Electricity Co.
November 17th, 1920.

Power Factor.

I have followed this interesting controversy hoping for some practical solution which could be easily assimilated by consumers, but so far this has not been forthcoming.

A fixed annual or quarterly charge per K.V.A. of demand, plus a unit charge, is undoubtedly the simplest and most understandable to the lay mind, but it is not necessarily equitable.

None of your contributors have touched the vital spot from the practical point of view; in fact, all appear to accept without demur the dictum last echoed by Mr. Stubbings on page 635 of your issue of November 12th, where he says "the excess K.V.A. cost the undertaking nothing for coal and use none of its boiler plant."

Let me give a practical refutation of this statement. Normally during factory hours the station P.F. is about 85 per cent., but during the night and week-ends this falls to 50 per cent. or less, mainly due to inefficient loading of transformers.

With such indifferent conditions it is necessary to run a 6,000-KW. turbo for a demand of 2,000 KW. only.

It is obvious that a 2,000-KW. turbo running at full load is more economical in fuel than a 6,000-KW. turbo working at one-third load, and it is a natural corollary that additional coal and boiler capacity are essential when such conditions prevail.

Conditions like the foregoing are only too frequent in industrial areas, otherwise the K.V.A. demand charge plus the additional unit charge would be quite fair.

Unfortunately from a tariff point of view, low P.F. is rarely coincident with peak loads.

H. Bentham.

London, W.C.
November 22nd, 1920.

I.E.E. Subscriptions.

In the current issue—page 661—you give the rates of subscription of the Institution of Civil Engineers, but I think you have omitted to state that "Resident" means a member whose office or place of residence is within 10 miles of London, whilst "Non-resident's" subscription is for members beyond that limit.

C. O. Grimshaw.

London, S.W.
November 22nd, 1920.

[We are obliged to our correspondent for the definition, which was not included in the particulars which we received from the Institution.—Eds. Elec. Rev.]

I should be grateful if you would kindly allow me to acknowledge receipt of the many letters and proxy papers, relating to the proposed increased subscription, which have been sent to me. Although I cannot reply to each individually, I have made careful notes of all the points raised, which I shall find helpful in connection with the matter.

I would urge upon the members—particularly the provincial ones—if they are opposed to the new subscriptions to send their proxy papers to me as soon as possible; otherwise the members present at the meeting, together with the Council's proxy vote, may carry the proposals.

F. W. Purse.

Stratford, E.
November 22nd, 1920.

There appear to have been very few criticisms raised against the proposed increase of subscriptions, but it is only natural that amongst the 8,000 members of the Institution some dissentient voices should make themselves heard. The broad view of the situation should be taken that as two successive Councils representing the membership have unanimously decided that the Institution needs this increase of income, and as the members' own personal experience in regard to general expenditure must convince them that pre-war subscriptions will not meet post-war outgoings, they should firmly support the action of their representatives and trustees. Whether they intend at present to attend the meeting or not, they should send in their proxies to the Secretary of the Institution, so that the resolutions may be passed by an overwhelming vote. Otherwise, as such meetings are more likely to be attended by the opposing minority than by the assenting majority, it might be made to appear that there is a cleavage in the ranks of the members, which I am sure does not exist.

G. W. Partridge, M.Inst.E.E.

London, S.W.
November 23rd, 1920.

The Use of Condensers.

Could you supply me with a few particulars as to the use of condensers in this country for the correction of power factor? I know that they are used in the States a good deal, but they do not seem to have made much headway in England. I should be much obliged if you could give me the name of any power system which uses them.

Student.

November 21st, 1920.

[An installation of condensers by the British Insulated and Helsby Cables, Ltd., was described in our issue of November 7th, 1919, in Mr. E. W. Dorey's articles on "The Improvement of Power Factor." The author stated that the company's output of condensers to September, 1919, was four times their whole output for 1918, and 27 times their output for 1914.—Eds. Elec. Rev.]

REVIEWS.

Electric Mains and Distributing Systems. By J. R. Dick, B.Sc., M.I.E.E., and F. Fernie, A.M.Inst.C.E., A.M.I.E.E. Pp. X +468+xvi. London: Benn Bros., Ltd., 1919. Price 18s. net.

We gather from the preface to this second edition of Messrs. Dick and Fernie's book that the war was the principal obstacle to its earlier issue. Our readers will probably remember that we pointed out when the first edition was published, that a second one, freed from the errors which marred the first, should be issued as soon as possible. The interval enforced by the war has afforded ample time for the careful and thorough revision, correction, and bringing up-to-date of the work. We are glad to say that this opportunity has been well utilised.

There was never any doubt that the authors of this book were the possessors, between them, of as great an equipment of technical ability and practical experience as any two men who could possibly have been selected to write a book on this subject. That was what made it such a pity that the first edition was so imperfect, and although Mr. Dick thought we were rather too hard on the publishers in our comments, we think he will by now have realised that it was because we were disappointed that the hopes we had based on the book's appearance had not been fulfilled.

Now that the book has been reprinted with the care that its importance warrants, with misprints and practically all errors removed, we unreservedly congratulate both authors and publishers on the publication of a work which must find a place on the most accessible shelf of every engineer worthy the name who is interested in distribution.

We think it would add to the usefulness of the book as a work of reference if the formulæ were numbered; and although they are correct there are signs omitted on pages 17 (foot) and 21. Kirchhoff's name has an "h" left out on pages 6 and 7, though it is correctly spelled on p. 101. On p. 9 we find "an uniform," and on p. 14 "a uniform." We regard the latter as correct, but it is at least a case where uniformity should be observed. The use of "further" for "farther," as on p. 25, is so common a mistake as almost to have become sanctioned by usage. On pages 25 and 26, so far as we can see, there is no difference in significance between *l* and L, and it is a little confusing to find them used indiscriminately. Not to labour this line of criticism, which is as tiring as it is thankless, we would commend to all writers who include numerous formulæ in their works, the propriety of not only numbering their formulæ, as suggested above, for convenience of reference, but of preparing a list of symbols, placing them in an appendix, and sticking to the same sign for the same thing and the same meaning for the same sign. We do not like to see kilowatt-hours called "kelvins," and a capital "K" cannot be justified in any event (p. 55). What authority do users of the term produce for their practice? Was there not once a proposition that ten units should be called one kelvin?

The layout of an electrical distribution system is a matter in which practical experience is the best teacher, but the greatest good results from the union of practical experience with theoretical knowledge, and the ability to apply the faculty of scientific analysis. It is stated at the conclusion of the first chapter that "the designing is possibly as much of an art as a science," and that "any network can be completely analysed by the application of Ohm's and Kirchhoff's laws, but there are no *simple* rules for constructing a network synthetically." Since the majority of engineers engaged in the distribution and supply of electricity are called upon to make the best use they can of some existing network, it is precisely the faculty of scientific analysis which is most needed, in order that the best judgment can be exercised as to whether any improvements can be effected. It does seem a little disappointing, however, after making lengthy calculations about the economy of stepping a distributor, as on p. 21, to be told, on turning over the page, that the theoretically possible saving is not generally attainable, the practical difficulties being too great.

On p. 112 the conclusion is reached that the amount of copper used will be a minimum if a constant current density is maintained. This must surely be modified in practice, or where would be the advantage of using a much higher current density in small conductors? The good old rough-and-ready rule of one thousand amperes per square inch has been abandoned for many years. We are glad to see emphasised the necessity of most carefully balancing the two sides of a three-wire network, and agree with the authors that this is best carried out by the card system. It is still far too often the case that the balancing is done in a haphazard way, with ill-kept records which are never consulted. There is no difficulty whatever in properly totalising the records when a separate card is used for each consumer.

It would be well to differentiate in some way between the word "outer," applied to a three-wire system, as on p. 122, and the same word applied to the external conductor of a concentric cable, which is presumably what is meant on p. 165. In the first case the "outer" is not earthed, and in the second case it is the "outer" and that only which is earthed. On p. 165 we are once again told of the futility of making calculations, and where resonance effects are of importance we are advised to use the oscillograph; and a "but" is somewhat significantly introduced into the footnote to that page: "A mathematical study of resonance, *but* with many practical points of view, is to be found in Mr. M. B. Field's paper, *Journal* I.E.E., June, 1903." On p. 173 the expression "unearthed" neutral is used. Since the neutral is not in this case exhumed, a better word, it seems to us, would be "non-earthed."

We think the question of heavy rushes of current on switching-in transformers might have been dealt with when considering the allied question of abnormal pressure rises. It has often been stated, even publicly, that such heavy current rushes, due in large measure to opposition between the sense of the residual magnetism and that of the current wave, can be prevented by switching in slowly. This, with an oil switch, would seem at least unreliable; and we wonder what experimental evidence could be adduced in support of the view that such action would be efficacious.

We should like some amplification of the statement made on p. 179 that three-phase transformers are costlier than those for single phase. The cost of three single-phase transformers for a given total output is undoubtedly greater, in all but the largest sizes, than that of a 3-phase transformer of the same

output; and the question whether a three-phase transformer of a given output is or is not more costly than a single-phase transformer of the same output depends almost entirely on a manufacturer's practice and factory lay-out.

We are quite sure that neither the I.E.C. nor the B.E.S.A. (referred to on pages 194 and 195 as the E.S.C.) speak of degrees Fahrenheit in any of their publications, and there is no reason why any engineer should do so. It was with some surprise, therefore, that we found sundry extracts from these standards translated into that scale on the pages mentioned.

On p. 196 the authors record their opinion that the shape of the conductors has little or no effect on the factor of safety of the cable at high voltages. We think this point might with advantage be developed somewhat, with reasons why it should be supposed that it had. On p. 207 it is stated that "every cable maker's composition is secret, and probably different." Well, we wonder! On p. 260 we think the authors are right in recommending the bonding and earthing of the lead as against breaking it at short intervals for the purpose of localising corrosion or burning. On p. 280 we read: "Vulcanised bitumen softens when heated, and the conductor tends to become decentralised. This statement is often made and nearly as often contradicted." We should not be inclined to attach much, if any, importance to a contradiction of this sort. It is very obviously an *ex parte* statement, and the clue is provided by the next sentence: "We believe the effect takes place far more readily with some makes than with others." Is it really an objection to the use of iron pipes that if a cable fails it is liable to cause a very bad earth and interrupt the supply? To our way of thinking, this is precisely what should happen. It conduces, among other things, to speed of repair, if the supply is completely cut off, and a lame supply is as bad as none at all. We are in complete agreement with the authors in advocating the employment of none but well-paid, thoroughly competent jointers. A bad jointer can cost more in the damage he brings about than could be saved on his pay in a hundred years.

The authors recommend that when a cable is to be hauled a rope should be attached to the core. We remember a contrivance like a wire stocking, which slipped over the sheathing, and the harder it was pulled the tighter it got. This device, we believe, was first used by Mr. Fedden. Is it still employed? We are glad to see due emphasis laid on the keeping of records and the correct allocation of all costs. Great pains are taken to get the costs of generation correct, down to the third place of decimals, but those relating to distribution are seldom so accurately known. There is a useful chapter on earthing and earthing devices, and incidentally the Bowden-Thompson system, in which metallic shields are introduced between the conductors, is not regarded with favour, for the reason that, in the authors' opinion, the stress in the dielectric is raised by as much as 70 per cent. In any case there would seem to be the same objection to the introduction of metallic shields as to the use of earth shields in transformers, to which many take strong exception, because it puts the candle too near the gunpowder. We must presume that the sentence on p. 361 which reads: "Carbon ends packed round the earth plate are sometimes used for lightning conductors" does not mean what it says. Perhaps carbon ends are sometimes buried round the earth plates of lightning conductors, but the sentence should be reconstructed.

We have devoted a good deal of space to the consideration of this book, because we think the subject with which it deals is one of the most important in the domain of electricity supply. The authors give careful and mature attention to its many aspects, and do not hesitate to give their own views, based on experience, even where they conflict with opinions generally held, and in some cases previously held by themselves. The book contains information of interest and value not only to the mains engineer, but to the general manager, the station engineer, and all engaged in central station work. In addition to these, the manufacturer will find in it things which he ought to know, whether he be a maker of cable, machinery, transformers, or switchgear. And, in conclusion, we are glad to have the opportunity of extending to the book the welcome we should have liked to have been able to give it on its first appearance.

U.S.A. Wages Fall.—With immigrants arriving in the U.S.A. from Europe at the rate of a million per annum, American labour leaders are becoming increasingly apprehensive at the prospects of widespread unemployment. It is true that they proclaim that the high wages established during the war period must not be reduced, but the fact remains, and it is an encouraging one, that wherever necessary curtailments of pay have been enforced they have been accepted. Striking illustrations of the fact are contained in Press reports which, *inter alia*, state that threatened strikes for increased wages in New York have been abandoned. Moreover, from Virginia comes the significant news that cotton factory employés have of their own volition voted for a reduction in wages of 25 per cent., and in the textile centres of Pennsylvania and New England wage decreases of from 15 to 25 per cent. have been decreed without dispute. In this country prices of various commodities have recently fallen and others show signs of following.

LEGAL.

THE BRITISH THOMSON-HOUSTON CO., LTD., v. THE CORONA LAMP WORKS, LTD.

THE following is an abstract of the judgment of the Master of the Rolls in this case upon the plaintiffs' appeal from the judgment of Mr. Justice Sargant, a summary of which appeared in our last week's issue:—

This appeal from Mr. Justice Sargant raises the question of the validity of certain letters patent No. 10,918 of 1913 granted to the plaintiffs for improvements in incandescent electric lamps. The lamp protected by the patent is known as the half-watt lamp, and has proved in practice to have the qualities claimed for it, and there has been a great and increasing sale of lamps made under the patent. I agree with Mr. Justice Sargant that the defences to the action are reduced to: (1) Want of invention or subject-matter; (2) insufficiency; and (3) non-infringement. I also agree with him that little importance is to be attached to the defence of non-infringement, and that it was proved by the evidence given before him, assuming the validity of the patent. The other two defences are, however, of much more importance.

The general history of the incandescent lamp is stated by Mr. Justice Sargant in his judgments, and I do not need to repeat it. The result was that in 1913 the tungsten vacuum lamp, for all practical purposes, held the field, and attempts at improvement had latterly taken the form of attempts to obtain a higher and more perfect vacuum.

There had, however, been attempts to produce gasfilled lamps, but the result had been unsatisfactory, because the loss of heat and therefore of light by convection or conduction exceeded the beneficial effect in preventing deterioration of the material by vaporisation.

The plaintiffs claim that they have overcome these difficulties, and that their discovery renders the introduction of gas into a metal filament lamp no longer a retrograde step, but an advance in lamp construction, which makes practicable a higher temperature, and therefore a greater incandescence without prohibitive vaporisation, and without excessive shortening of useful life. It seems to me that the essential discovery is that the conduction and convection losses can be overcome and counteracted by increasing the temperature and incandescence without shortening the life of the lamp if with a suitable gas and a suitable pressure the filament employed of tungsten or other suitable metal is large in diameter or cross-section. I shall have to examine later the meaning of the word "large." It is thus described by Mr. Swinburne, an expert witness called by the plaintiffs: "The invention is this; it can be put very shortly, it was found that a tungsten lamp could not be run commercially under something in the neighbourhood of 1 watt per candle, the reason being that if you tried to run it at a higher efficiency the tungsten went off and blackened the lamp. Langmuir realised that if he put the gas in he might stop this vaporisation of the filament, but he also realised what was most important, that the ordinary case of putting a gas in would carry away heat by convection: he realised if this filament was thick the lighting power increased directly as the diameter, but the convection did not increase nearly so fast, therefore, if he started, as it were, a race between the two, he could succeed at a certain diameter in getting a higher efficiency with a decent light than he could before, because by using a thicker filament the convection did not increase in proportion, and so he is enabled to solve the difficulty. It is not that he is merely getting a little advantage, it is that he has really a tremendous advantage, and this change in lamp manufacture is a very fundamental change, and one of enormous commercial importance. It is the biggest step in lamp making that I know of." The specification points out that a large, or as it is sometimes called, a thick filament, may be obtained by increasing the size of a straight filament or by using a smaller filament and coiling it closely so as to produce something approaching to a cylinder. It does not, however, point out that in making a small lamp of low candle power such as is suitable for domestic use, it is necessary to obtain the benefit of the invention that the filament should be coiled. That it is necessary in such a lamp to coil the filament seems to be admitted by the appellants' counsel.

In order to prove their defence of want of subject-matter, the defendants referred to a number of earlier patents in which it was said that the whole of the subject-matter of the patents was to be found. Mr. Justice Sargant examined these earlier patents minutely, and came to the conclusion that the disclosures contained in them were not such as to deprive the plaintiffs' patent of subject-matter or inventive merit. I agree with his comments upon, and the conclusions he draws from, these earlier patents. The new element introduced as to the old knowledge by this discovery is, as Mr. Swinburne says, that by using a filament of large diameter or cross-section, whether it be what was called primarily large or secondarily large, namely, a filament in itself thin but having the effect of a thick filament by being closely coiled, the advantages of the introduction of gas may be obtained without the disadvantages which up to then had accompanied it. The appellants' counsel contended that the discovery and the invention extended beyond that of largeness in the filaments, but I am unable to see that this is the case, and Mr. Swin-

burne does not seem to claim anything beyond the use of a large filament.

It remained to examine whether Mr. Justice Sargant was right in holding that the patent was bad from insufficiency, because there was no sufficient definition of largeness to show the ambit of the monopoly claimed. The description of the filament in the first claim is "a filament of tungsten or other refractory metal of large diameter or cross-section or of concentrated form," the latter expression referring to the filament when closely coiled so as to produce the effect of a large cross-section. There seems to have been some discussion at the trial before Mr. Justice Sargant, but before us the meaning stated by him in his judgment was accepted by the appellants' counsel. It is as follows: "In other words, 'large' must not be regarded absolutely in relation to mere diameter or thickness, but is limited or modified in relation to results, and means sufficiently 'large' to take advantage of the new discovery as to convection and conduction losses enunciated at the foot of page 8 of the specification, and accordingly to produce such a combination that much higher temperature and incandescence may be obtained with a commercial length of life."

As I have said, the real discovery is that by the use of a large filament the introduction of gas into the lamp is made possible and good results obtained from it without the corresponding disadvantage of convection and conduction losses. The actual degree of largeness must vary according to a large number of varying circumstances in the manufacture of different lamps, and it seems to me that the only way in which the requisite degree of largeness can be ascertained is by a number of experiments under the special conditions in which a particular lamp is manufactured. Similarly, as pointed out by Mr. Justice Sargant, the only way in which a lamp maker can ascertain whether he is infringing the patent is by making experiments for the purpose of ascertaining whether a gasfilled lamp attains such a degree of efficiency and such a length of life as to fall within the patent.

This, in my opinion, is too vague a definition of largeness to describe the nature of the invention or limit the ambit of the claim, and, therefore, I think the decision of Mr. Justice Sargant was right, and the appeal must be dismissed with costs.

The Lords Justices delivered judgment to the same effect.

An Electricity Supply Contract.

Application to Annul.

The North Metropolitan Electric Power Supply Co., of Broadway House, Westminster, were the applicants to Mr. Justice P. O. Lawrence, in the Chancery Division, on Thursday, upon an adjourned summons, for an order suspending or annulling four agreements made for the supply by them of electrical energy to the Corporation of Stoke Newington, or by consent amending them, on the ground that owing to the alteration of trade conditions occasioned by the war the contract could not be enforced without serious loss to the plaintiffs.

Mr. Tyldesley Jones, K.C., and Mr. Craig Henderson appeared for the plaintiffs; and Mr. C. E. E. Jenkins, K.C., and Mr. Merlin for the defendant Corporation.

Mr. Jenkins said he imagined that it was not a case for suspension, but for annulment, otherwise the people of Stoke Newington would have to go in darkness.

Mr. Jones said that would not be possible because even if his Lordship should decide in his favour it was obvious that a reasonable time would have to be allowed in order that the defendants might make arrangements to get their electricity elsewhere. The plaintiffs wanted the contract cancelled because they were making a very heavy loss on it. The main cause of the increase in the cost of production was the rise in the price of coal and labour, due to conditions arising out of the war; and this entailed serious hardship on the plaintiffs. They were under a statutory obligation to supply the defendants with energy even if the agreements were torn up. Under their Act they were bound to give every authorised distributor in their area a supply, and in certain cases the maximum prices were specified in the Act, but where the distributors did not take the whole of their supply from the plaintiffs then it was a matter for arbitration.

Mr. Jenkins said the plaintiffs had to make out not only that there had been an alteration in trade conditions occasioned by the war, but that they were suffering serious hardship within the meaning of the special Acts of Parliament.

An affidavit had been sworn by Mr. E. T. Ruthven-Murray, general manager and chief engineer to the plaintiff company, in which he said that the increased cost of producing electrical energy was chiefly due to the increased cost of coal, and in a minor degree to the increased cost of labour. Even if they obtained any benefit from the order recently made for the reduction of 10s. per ton in the cost of coal used in the production of electrical energy for domestic and household purposes, that benefit must be passed on to the defendants. Since that order was made the price of coal had again risen owing to the increase in the cost of railway and coastwise freights, and the plaintiffs would be compelled by order of the Controller of Coal Mines to use inferior grades of coal and slack which were uneconomical and unsuitable for use in the mechanical stokers of the plaintiffs' boilers. In consequence of all this, the plaintiffs were making a heavy loss on the contract. In February last year they offered to amend the agreement by the insertion of a "coal clause," providing for an increase in the price of energy in proportion to the increase in the price of coal, but they had never been able to obtain a reply from the defendants.

The affidavit was read by Mr. Tyldesley Jones when the hearing was resumed on Friday, when he said that a summary statement contained in it showed that costs were falling down to the time when the war began, with increasing profits, while since then costs had been gradually rising.

His Lordship: There is no hope of a reduction in the cost of coal and freight?

Mr. Jones said unfortunately it could not be seen at present, but the plaintiffs agreed that such a thing might happen some day, and that was one of the reasons why they suggested the insertion of a "coal clause" in the contract. He put in a table which, he said, had been published in the Electrical Review, showing the comparative charges by distributors and power companies for light and power from 1914. In that connection he said that, according to his instructions, Stoke Newington was the only local authority that had not raised its charges.

Mr. Jenkins read an affidavit by Mr. Colin Stuart Hann, electrical engineer to the Borough of Stoke Newington, in reply to that of Mr. Murray. He said that in his opinion the annulment of the contract would deprive the defendants of the benefit of the competition which resulted in the agreements. The plaintiff company was a wealthy corporation, supplying a great number of large customers, amongst others the Middlesex Tramways. In that connection they had to maintain a surplus of energy, and the amount they supplied to the defendants was so small that it might be regarded as being supplied out of that surplus or waste product, and that was why they had been able to supply the defendants with energy at below cost price. With regard to the offer, he said the plaintiffs broke off negotiations.

Mr. Jones said there was no such thing as waste product in relation to the supply of electricity.

The affidavit then dealt with figures concerning cost of production, and concluded by stating that in the opinion of Mr. Hann, the increase of cost caused by the deduction of the amount of energy supplied to the defendants from the total amount of energy produced by the plaintiffs should be almost inappreciable.

Mr. Jenkins read further evidence dealing with the coal position, and said that it was common ground that the rise in the price of coal at first was due to the war, but it was open to question whether the later rises were not due to the peace.

At the adjournment, Mr. Jones said that the offer to the defendants with regard to the coal clause was still open, but there must be a time-limit to it. He could not fight with his hands tied.

Mr. Jenkins said he was not pressing the other side to keep the offer open, and he was not going to say that he accepted or refused it.

Mr. Jones said it remained open until the next time the case was heard, and he would not withdraw it before.

Mr Jenkins then said that the defendants preferred to take a decision of the Court.

The summons was thereupon adjourned to a day to be fixed.

A Misunderstanding.

At Blackburn County Court, on Monday, Thomas Speak, electrical engineer, claimed from Thomas W. Foster, engineer, of Montague Street, £13 10s. for work done. Defendant paid £8 10s. into Court. It was stated that plaintiff agreed to install a 2-h.p. motor engine for £8 10s., and a 6-h.p. motor for £5. Defendant said the £8 10s. was to cover both jobs.

His Honour gave a verdict for £12, and said there had been an honest misunderstanding between the parties.

Malicious Damage.

At Holmfirth, last week, Hirst Taylor and Harry Heeley were each fined £5 and 35s. costs, for maliciously damaging an electric light globe in a Great Central corridor train travelling between Penistone and Brockholes. Each dared the other to kick the globe down, and eventually Heeley did so.

Obtaining Electrical Goods by False Pretences.

At the Central Criminal Court, on Tuesday, last week, Edward Adames, 47, described as an electrician, pleaded guilty of obtaining quantities of electrical goods by false pretences from the Edison Swan Electrical Co., Ltd., and the Sun Electrical Co., Ltd. Mr. Fortune, who prosecuted, stated that last May the prisoner went to the premises of the Edison Swan Electrical Co., Ltd., and ordered a quantity of electric lamps. He promised to pay the next day, and in order to obtain the goods handed over a trade card containing the name "Edward Adames & Son, electrical contractors, 12, Savoy Rise, Savoy Street, Strand." On the strength of this statement he got possession of the goods, but it subsequently turned out that no business of any sort was carried on by him at the address given. Two days later

he again called at the prosecutors, and obtained further goods for which he gave a cheque, which was dishonoured on presentation. In September he obtained goods in a similar manner from the Sun Electrical Co., Ltd. A police officer stated that the accused had been an electrical engineer for many years, and he appeared to have obtained orders from various householders for electrical work, receiving money on account, but did not carry out the work. By means of a worthless cheque he had also obtained electrical goods from the British Thomson-Houston Co.

The Recorder sentenced the accused to 12 months' imprisonment with hard labour.

Research Grant Protest.

As has been previously mentioned in the Electrical Review, on August 5th last the shareholders in Messrs. Brunner, Mond and Co. agreed to a resolution authorising the directors to distribute the sum of £100,000 from the investment surplus reserve account among selected universities or other scientific institutions for the furtherance of scientific education and research. As a consequence of this resolution, Mr. Evans, a shareholder in the company, who at the meeting voted against the resolution, applied to the High Court for an injunction to restrain the company from disbursing the amount agreed upon.

Before Mr. Justice Eve, Mr. Clayton, K.C., for the plaintiff, submitted that the resolution was *ultra vires* of the company, and therefore could be objected to by one shareholder. The main object of the company, as set out in the memorandum of association, was to acquire the business of Brunner, Mond and Co., chemical manufacturers, but it was also stated that the company took power to undertake any business incidental and conducive to the carrying out of the main object. Mr. Justice Eve observed that the case seemed to resolve itself into a decision as to whether the disputed sum was to be devoted to an object incidental and conducive to the main object, and Mr. Maugham, K.C., for the defendants, said that was his clients' case. Mr. Clayton maintained that a limit had to be set to the disposal of money in this way, and the object should be conducive in a specific and not in a general manner. In his judgment, Mr. Justice Eve said that it was urged on behalf of the plaintiff that the terms of the resolution were too vague, but he (his Lordship) could not agree. He felt some difficulty, however, in the definition of the furtherance of scientific education and research, but could not disregard the evidence of the directors who were specialists in the business. The directors said that the grant would tend to train men whose services would eventually be advantageous to the company, and that seemed to his Lordship to dispose of the criticism that it was too general and not confined to a special branch of science. The evidence showed that the company had experienced difficulty in obtaining the right class of men, and the provision of this fund would enable an efficient body of men to be brought into existence by whose services the company would benefit. In the circumstances, his Lordship considered that he ought not to interfere by injunction, and he would therefore make no order.

THE SHIPBUILDING, ENGINEERING AND ELECTRICAL EXHIBITION.

(*Continued from p. 667.*)

Messrs. Brecknell, Munro & Rogers, Ltd.—A representative collection of electric traction and haulage gear is to be found on this stand. The exhibits include the Brecknell electric signal for suburban lines and light railways. The whole of this apparatus, with the exception of the lamp boxes, is placed on the overhead line. A mechanical "off" contact is fitted, which renders sticking of parts, owing to the coils becoming heated, impossible. A new type of pantograph current collector (fig. 9), in sizes of from 10 to 500 amperes, is shown. This collector is made with either one or two collector bows in aluminium or copper. The largest size will rise to wires fixed 7½ ft. above the roof of the vehicle on which it is mounted. Other exhibits are double-pole collectors, three-phase pantograph collectors, slip-ring collectors, trolley heads of various types and sizes, collector shoes, trolley wire ears, hangers, insulators, switchgear, moulded mica and rubber insulation, &c.

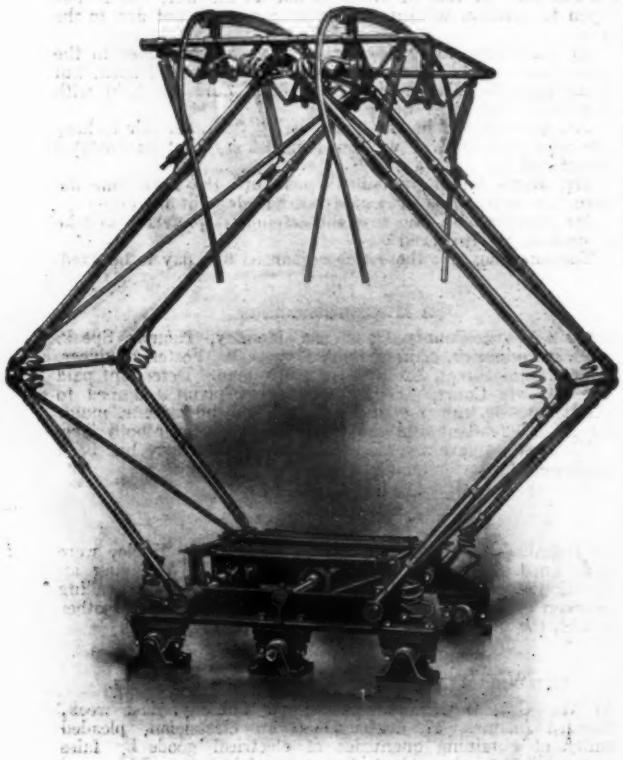


Fig. 9.—Pantograph Current Collector.

Messrs. Telford, Grier & McKay.—This exhibit consists of Morse lamps and semaphores, an "Electolite" lighting set, a shipyard electric winch, and ships' electrical installations. A "W.G." tell-tale forms a feature of the display. This is connected up to five lights representing the navigation lights of a vessel. Small indicating lamps show whether the navigation lights are "on" or "off." Should any of the lamps fail, a solenoid drops and closes a warning-bell circuit.

Messrs. Kelvin, Bottomley & Baird, Ltd.—Among many other instruments, this firm shows examples of its "Pneumercator" tank gauge which, in addition to indicating the liquid head, can be calibrated to give a direct reading of the corresponding weight or volume. An electric annunciator may be fitted to the instrument to indicate predetermined mean, maximum, minimum or other levels. The mercury in the device makes and breaks its own connections at the determined point, thereby operating an indicating hand on the annunciator and ringing an alarm bell. To accomplish this, the only wiring necessary is between the mercury columns and the annunciator. Diaphragms and floats are entirely obviated. The "Denny-Edgecombe" torsionmeter (fig. 10) is a notable feature of the stand. This device is actuated by the angular twist of a known length of the shaft transmitting the power to be measured. Two members of the torsionmeter are rigidly attached to the shaft at a specified distance apart, and the relative angular movement is transmitted through a step-up system of balanced levers to a contactor-arm moving over a specially constructed rheostat carried by and rotating with the shaft. The current in a local circuit, including a differentially-wound indicator, is controlled by the position of the rheostat contactor-arm and the indicator is calibrated to read directly the H.P. transmitted at a

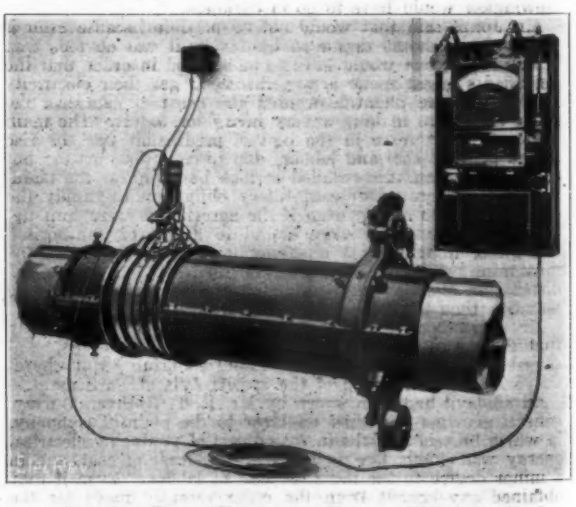


Fig. 10.—Denny-Edgecombe Torsion Meter.

known speed of revolution, or alternatively, the torsion in the shaft, as may be desired. The contactor arm rubs on the resistance ribbon only while a reading is being taken, *i.e.*, so long as a push-button is depressed. Other features of the exhibit are draught indicators, sextants, barometers, &c.

Messrs. Holophane, Ltd.—One of the brightest spots in the Exhibition is this company's stand, displaying examples of scientific lighting. On the front of the stand are three pairs of lamps exemplifying extensive, intensive, and focusing lighting systems, together with curves showing the distribution of the rays. Industrial-type lanterns are shown, as well as street-lighting lanterns fitted with band and bowl refractors. A special "anti-glare" motor-car head light is contrasted with the usual design. Asymmetrical fittings with a reflecting back and diffusing front, angle reflectors for shop-window lighting, and reflector-refractors for offices, are included among the exhibits. A tastefully coloured bowl giving pleasing results—the "Decolite"—is also on view. A collection of photographs shows the results obtained from lighting systems installed by the firm.

Messrs. W. McGeoch & Co., Ltd., have an extensive display of switchgear and fittings for ships' electrical installations. On the stand is a marble switchboard built to comply with the latest Lloyd's rules, and fitted with quick-break knife switches and Home Office type fuses. "Klidos" switch and fuse-boxes, water-tight bulkheads and glands are also exhibited. In the centre of the stand is a complete full-sized model of an electrically-fitted state-room with every modern appliance to hand. The bulk of the material exhibited is made in Birmingham.

Messrs. Simplex Conduits, Ltd., show an extensive and attractive display of domestic electrical devices of all kinds, including "Plexeim" fires, kettles, irons, electric light fittings, &c. The well-known conduit is not given much space, but a new type of ironclad distribution board fitted with special fuse units so mounted as to make wiring easy, and to facilitate inspection, is shown. This is accomplished by hinging the interior on pins, enabling the whole to be lifted out at either end. Another feature of these "Diaduct" boxes is the method of entry provided for the cables. The sides of the boxes are slotted out and removable troughs, drilled as required, may be easily fitted. This feature is valuable when alteration of drilling is required when the box has been fitted in position. The boxes are made in sizes of from two to twelve ways of 15 amperes per way.

Messrs. Dent & Co. & Johnson, Ltd.—This firm, which is associated with the installers of "Big Ben," exhibits a wide selection of navigational instruments, including ships' compasses, binnacles, &c. "Johnson's Patent" loud-speaking telephones for communication between various stations on board ship are shown. These are very efficient instruments, absolutely water-tight and unchanged by varying climatic conditions. All working parts are totally enclosed. A special type of bell is fitted, which is also suitable for mine signalling.

The Morgan Crucible Co., Ltd.—This firm displays a number of carbon brushes for dynamos and motors, magneto carbons, carbon switch contacts, telephone electrodes, diaphragms, &c., welding carbons and carbon powder resistances.

The Harland Engineering Co., Ltd., and the British Electric Plant Co., Ltd.—A comprehensive display of electrical gear, &c., is to be found on this stand. A speciality is mill motors, both A.C. and D.C., and a 150-H.P. paper-mill motor is one of the largest machines in the exhibit. Internally ventilated by an enclosed fan, this is a good machine for satisfactory performance in wet and dirty situations. The Harland patent speed interlock is shown, which possesses the advantages of obviating heavy belts, cones, &c., permitting rapid changes of speed, and abolishing heavy, light-obstructing driving mechanism. The action of this apparatus is best illustrated by the diagram, fig. 11, and may be briefly described as follows:—A shaft A runs through the entire length of the paper machine, and is driven by a small motor. This master shaft drives, by means of bevel gears B, a spur shaft C. There are as many bevels and shafts, &c., as there are individual motors driving different sections of the paper machine—that is to say, if 10 motors are used to drive the paper machine, there would be 10 units of gear. Each spur shaft C is coupled to a differential gear D, the other end of the differential is coupled to shaft E, upon which is mounted a small cone pulley H, which is driven by a similar cone pulley H mounted on the shaft of the main sectional motor driven by belt L. The two pulleys K represent guide pulleys for the belt L; these pulleys are in practice mounted as near as possible to the pulleys H, ensuring that, when once set, the belt L will not wander over the face of H. If the shafts C and E, coupled up to and supporting the differential D, are running at different speeds, the case of the differential D enclosing the gear must revolve. This feature of the differential has been made use of. The differential D is surrounded by a stationary shunt regulator M, with a moving arm G mounted on shaft E. The shunt regulator M controls the speed of motor F, and is in circuit with it. If the case of the differential D revolves, and with it the shunt regulator arm G, immediately the speed of motor F is altered, and synchronism is effected automatically between spurs C and E, and the switch arm G remains on one contact of the shunt regulator until any further factors operate to change either the speed of the master motor or sectional motor F; the arm G will then simply move slightly and will remain on that contact of the shunt regulator as will give the same speeds to spurs C and E. The pulleys are used to give different drafts between the various sections of the paper machine—15/20 per cent. speed change is generally provided for; O in the sketch shows a screw shaft which goes to the operating side of the paper machine on the other side of the wall. By turning this shaft a few revolutions the operator can change the draft between sections within the limits of the cone pulleys—that is, about 15/20 per cent. The belt L has no power to transmit except that required to overcome ball-bearing friction. The belt is made relatively heavy so as to ensure slipless drive, and this has been shown to be obtained in practice. The speed of the whole paper machine is changed by altering the speed of shaft A. Immediately this is done, all the shafts E for a moment run out of harmony with the master shaft; as a result, all the differential gear cases move the shunt regulator arms G to such a position on the shunt regulators as will give individual harmony with the master shaft; complete rest and synchronism is then attained, and the whole

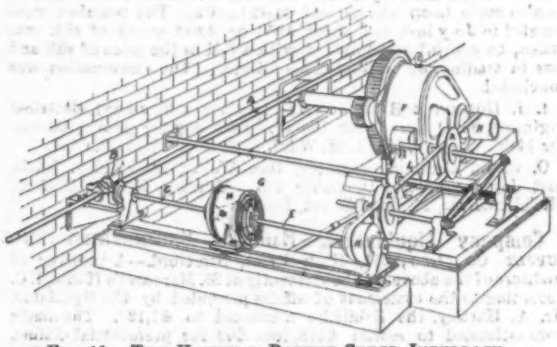


Fig. 11.—The Harland Patent Speed Interlock.

machine runs as if mechanically interlocked at the same draft. No more relative movement can then take place than would be possible if the different sections of the paper machine were coupled together by gears. This arrangement gives, in addition to the interlock, the greatest flexibility and ease of operation.

A "Crescent" coal-cutter is exhibited. This machine has its gears entirely enclosed in strong cast-steel boxes. Lubrication, an important item in this class of machine, is effected by a plunger pump fitted in the bottom of the gear box. The coal-cutter is in parts easily assembled in the mine and giving great rigidity. A mine distribution fuse box, gate-end boxes, switchgear, &c., are shown. In addition to these, there are pumps for water and tailings from metalliferous mines.

The Marconi International Marine Communication Co. Ltd.—This stand includes a replica of the wireless telegraph cabin of a modern ship, in which is fitted a main-spark set rated at 1½ KW., a main continuous-wave set of the same nominal power, and a smaller 1½-KW. set. The transmission side of the first set works over a guaranteed range of 400 miles. The receiver is of the "31-A" type, in circuit with a new heterodyne receiver embodying a four-electrode valve. For shorter ranges the amplifying panel of a D.F. set is used for reception purposes. The C.W. panel may be used for a range of 1,000 miles, but is capable of a much wider application. The range of the emergency set is from 80 to 100 miles. The most important features of the apparatus are the small amount of space which it occupies, the fact that a silence cabin is unnecessary, and that the sets are practically fool-proof, being so simple in operation.

Messrs. W. Brown & Co.—This Glasgow firm shows a wide range of electrical fittings and plant of many descriptions. The exhibit includes cables, rubber and bitumen insulated and lead-covered, and armoured; storage cells in glass, and ebonite cases by Fuller's United Electric Works, Ltd., as well as arc lamp carbons, &c., by the same firm. The products of the Midland Electric Manufacturing Co., Ltd., shown, include ironclad switches, two and three-pole, up to 200 amperes and 600 volts, fuses and distribution boxes. Motors manufactured by Messrs. Horace Green and Co. are shown. These are D.C. motors of the enclosed ventilated type up to 100 B.H.P., and A.C. motors up to 200 B.H.P., and for all frequencies, squirrel-cage, made and fitted with solid welded rotor end rings, ball and roller bearings. Other firms represented on this stand are Watertight Fittings, Ltd. (cast-iron, brass and sheet metal fittings for lighting, &c., and special bulkhead fittings); New British Electric Supply Co., Ltd. (D.C. and A.C. totally-enclosed, continuously-rated, low-temperature motors); and Messrs. S. G. Leach & Co. (table, desk, and bracket fans, motor-driven sirens, A.C. or D.C., propeller fans, and small motors for polishing and buffing).

Messrs. Vickers, Ltd.—A large space has been taken up by this firm, which shows broaching machines, box-making machinery, railway materials, sewing machines, miniature rifles, hydraulic valves, and an electrically-driven Williams-Janney hydraulic winding engine, &c. Associated with Vickers, Ltd., are the Iodo Rubber and Waterproofing Co., Michell Bearings, Ltd., White, Jacoby & Co. (portable electric drills, magnetic adhesion electrical drills, and armatures and components), T. Cooke and Sons, Ltd. (surveying instruments, and instrument-making machine tools), Vickers-Petters, Ltd. (electric lighting sets, oil engines and winches), and Messrs. S. F. Saunders, Ltd.

(To be concluded.)

BUSINESS NOTES.

Bankruptcy Proceedings.—J. J. Symons (Zodiac Peerless Electric Lamp Co.), 25, Denmark Street, Charing Cross Road, W.C.—The public examination was held on November 16th, before Mr. Registrar Mellor, at the London Bankruptcy Court, of this debtor. The accounts showed liabilities £2,200 9s. 2d., against assets valued at £216 2s. 8d. The debtor stated that he joined his father in partnership, and they commenced the above business in October, 1918, with a capital of £200. The partnership was dissolved in November, 1919, when witness gave his father a promissory note for £200 in respect of money the latter had advanced to the business. He subsequently continued it alone, but under the same style until last August. After the dissolution he also made lamp shades, and dealt in silk. The premises were burgled in July last, and about £250 or £300 worth of silk was stolen, to which loss, combined with a fall in the price of silk and loss in trading, he attributed his failure. The examination was concluded.

I. J. Hodson & B. H. Newman (Hodson & Newman), electrical engineers, 85, Queen Street, Exeter. Last day for proofs, December 14th. Trustee, Mr. A. H. Ward, 9, Bedford Circus, Exeter.

O. Carr, electrical engineer, Oak Works, Headingley, Leeds. Last day for proofs, December 8th. Trustee, Mr. H. Clifford, official receiver, 24, Bond Street, Leeds.

Company Liquidation.—Eastern Engineering and Supply Co., Ltd., 351, High Street, Stratford.—A meeting of creditors of the above was held recently at St. Margaret's House, E.C. According to the statement of affairs presented by the liquidator, Mr. A. Hartley, the liabilities amounted to £1,120. The assets were estimated to realise £138, less £69 for preferential claims, leaving net assets of £69 9s. 9d., or a deficiency of £1,050. The assets consisted of stock-in-trade expected to produce £4; fixtures and fittings, £10; good book debts, £114; and doubtful and bad debts, £203, estimated to produce £10. It was stated that the Sheriff recently levied execution on behalf of certain creditors, and sold practically the whole stock-in-trade. The stock was estimated at that time to be worth £300, but it only realised just a little over £130. The company had a little work still in hand, which was not yet completed, while the tenancy agreement was expected to be worth something, and the liquidator stated he hoped to receive £25 for it. Dissatisfaction was expressed at the situation disclosed, and the creditors decided to confirm the voluntary liquidation of the company with the liquidator appointed by the shareholders.

Dissolutions of Partnership.—Saunders, Garner and Mothersdill, electrical motor and mechanical engineers, 249, Regent Street, Salford.—Messrs. A. Saunders, F. Garner, and F. Mothersdill have dissolved partnership. Debts will be attended to by Mr. F. Garner and Mr. F. Mothersdill, who will continue the business.

Almer, White & Co., general and electrical engineers, Shard Mews, Hill Street, Peckham, S.E.—Mr. H. Thompson, Mr. A. Ducat, and Mr. C. A. White have dissolved partnership. Mr. H. Thompson and Mr. A. Ducat will attend to debts and continue the business under the style of Ducat & Thompson.

Trade Announcements.—The Northern Electrical Supplies Co., of 23, Bank Street, Bradford, wish to notify the electrical trade that they have no connection whatever with any firm of contractors in Bradford trading under a similar name.

Anglo-Overseas Engineers and Merchants, Ltd., have removed from "Hastings House," 10, Norfolk Street, Strand, W.C. 2.

Mirrlees, Bickerton & Day, Ltd.—We are informed that on and after November 22nd, 1920, the London office will be Mirrlees House, 7, Groavenor Gardens, Westminster, N.W. 1. Telephone number: Victoria 9123. Telegraphic address: Crudoil, Sowest, London.

Catalogues and Lists.—The British Thomson-Houston Co., Ltd., Mazda House, 77, Upper Thames Street, E.C. 4.—Two folders illustrated in colour and by photographic reproductions. One deals with bowl fittings for semi-indirect lighting and the other with "Mazda" electric lamp bulbs for motor-car, &c., lighting; both folders are fully priced.

The Newman Electrical Co., 64, Newman Street, W. 1.—A net trade price-list (12 pp.) of electrical accessories and general wiring supplies, including bells, cut-outs, batteries, switches, &c.

Julius Sax & Co., Ltd., 24a, High Street, New Oxford Street, W.C. 2.—A priced and illustrated catalogue of opal glass, "Holophane" glass and alabaster bowl reflectors and fittings, and also wall plugs, lampholders, "candle" fittings and interlocking switch plugs.

Sterling Telephone and Electric Co., Ltd., Telephone House, 210-212, Tottenham Court Road, W. 1.—Publication 284, an illustrated price-list of telephones with throat microphone transmitters and accessories.

Hudson's Electrical Engineering Co., Ltd., 7 and 8, Prudential Buildings, Leeds.—A blotter bearing a picture of a motor and advertising two and three-phase squirrel-cage and slip-ring types.

The Edison Swan Electric Co., Ltd., Ponders End, Middlesex.—An illustrated and priced leaflet dealing with the "Ediswan" electric fire.

Economic Electric, Ltd., 10, Fitzroy Square, W. 1.—A catalogue (20 pp.) of wireless apparatus. Very fully priced and illustrated, with index of listed articles. Also includes a list of published works on wireless telegraphy and telephony.

Thomas Broadbent & Sons, Ltd., Central Iron works, Huddersfield.—An illustrated and detailed catalogue (30 pp.) of A.C. and D.C. electric hydro-extractors, motors, and switchgear.

Book Notice.—"Telegraphy." By T. E. Herbert. Fourth Edition, with Addendum. Pp. xx + 1,020; 640 illustrations. London: Sir I. Pitman & Sons, Ltd. Price 18s. net.

The Electric Propulsion of Ships.—We are informed that an application for a British patent (No. 133,301), which has been lodged by Messrs. Brown, Boveri & Co., Ltd., will be opposed by Capt. W. P. Durtnall, on the ground that the use of a self-starting synchronous polyphase motor for driving the propeller shafts of ships has been covered in previous lay-outs for his 'Paragon" system.

Municipal Representatives on an Industrial Council.—The Hampstead Borough Council has passed resolutions stating that while in sympathy with the principles of the Whitley Councils, it considers that the present constitution of the Metropolitan District Council of the J.I.C. for Local Authorities' Non-Trading Services (Manual Workers) is not such as will guarantee impartial consideration of questions relating to wages. This is said to be due to the fact that a number of representatives of Borough Councils sitting on the body are Labour members of those Councils. The resolutions call for the appointment of an independent body as a tribunal of first reference. The Battersea Borough Council is replying that while it agrees that it is inadvisable for municipal authorities to be represented by Trade Union officials, it resents the implied suggestion that Labour members of Borough Councils are unlikely to give impartial consideration to the wage questions brought before the Metropolitan District Council.

Lead Report.—In their report dated November 20th, Messrs. James Forster & Co. say:—Closing prices yesterday were £32 10s. for November, and £31 15s. for February, a reduction on the week of 40s. and 35s. per ton respectively. The bottom values of £32 for November, and £31 15s. for February were done on Wednesday. Business has been extraordinarily active, the turnover being over 7,000 tons, the selling most aggressive, and the loss on each of the first three days of the week 20s. to 30s. per ton. Thursday—the most active day, when 2,500 tons changed hands—showed an advance of 15s. per ton for all positions, but yesterday the market again eased off about 5s. per ton. On Monday, outside the market, nearly 1,000 tons were sold for prompt shipment, much of it at £36 5s. and £36 10s. f.o.b. Consumers have bought largely, chiefly for early delivery, but also for next year. The Broken Hill Associated Smelters expect to commence shipping in February; the production expected is 7,000 tons per month, of which 4,500-5,000 will be available for export.

Messrs. G. Cawson & Co. say that the unexpected supply of prompt lead from France encouraged sales of considerable quantities of forward lead at low prices. Consumers in some instances have taken advantage of these forward sales to cover their future requirements. The outlook still points to an unsettled market. Should speculators, however, cease their operations of selling forward lead, we should look for some recovery.

Copper and Lead Prices.—Messrs. F. Smith & Co. report November 23rd.—Copper (electrolytic) bars, £95, £7 decrease; ditto sheets, no change; ditto wire rods, £111, £7 decrease; ditto H.C. wire 1s. 2d., ¼d. decrease.

Messrs. James & Shakespeare report November 24th, copper bars (best selected), sheets and rods, £113, £6 decrease; English pig lead £30, £3 reduction on last week's quotation.

The "Paragonisation" of Tramways.—Referring to the serious financial situation of the British tramway industry, Captain W. P. Durtnall suggests that a solution to the problem is to be found in the general application of the "Paragon" thermo-electrification system. The tramcars under this system would in most cases carry their own propulsive energy in the form of the new super-Diesel "Paragon" internal-combustion engine, using heavy fuel oil, or residue from gas works. This engine drives a small generator mounted under the car, and the same overhead lines, or slot system of conductors, may be utilised to allow an electrical exchange of energy automatically to take place between the various cars, whether they be starting or climbing grades or regenerating and running down grades, &c. The energy at present supplied from central power stations will no longer be required, and this release will in many cases be welcome, as the energy now used for tramcars can, of course, be used for lighting and stationary power purposes, &c. It is very doubtful, he says, if the overall thermal efficiency with the present system is more than 5 to 6 per cent., but with this new system it can be raised to at least 25 per cent., and with the credit due to regeneration it will possibly rise to 32 per cent; in that case a very great reduction in the fuel consumption per car-mile will result. The same car-sheds would, of course, be required, and also the repair plant, but no power station would be wanted.

Inquiries.—Makers of the "Emeralite" electric table lamp fitting, of armature coil pullers and winders, and of brass rings and chains for bowl fittings, are asked for.

B.T.H. Smoking Concert.—On the evening of the 19th inst., the Willesden drawing office staff of the British Thomson-Houston Co., together with many members of the engineers, general, and works staff, laid aside all their business troubles and worries and spent a most enjoyable social evening. Prior to the concert, and promptly to time—in accordance with B.T.H. punctuality—84 members made a prearranged attack on the staff canteen, and did justice to a palatable tea, which was provided by the company.

Before the commencement of the concert the chairman and Mr. E. J. Blackaby gave the toasts: "The King" and "Our Fallen Heroes," respectively.

The works manager, Capt. C. R. Acklom, R.N., C.B., C.B.E., in response to the toast of "The Company and the Manager," most suitably given by Mr. H. C. Heath, expressed his thanks for the reception and for coupling his name with "The Company." After expressing his pleasure at being present, he remarked upon the great activity of the electrical industry throughout the United Kingdom, and upon the high pressure under which the Willesden works was working.

The toast of "The Visitors" was cordially given by the chairman, and responded to by Messrs. T. Hatton (works superintendent) and J. H. Castell (late of the B.T.H.).

Much credit is due to Mr. Leggett (works staff) for the brief and concise manner in which he toasted "The Artistes, Committee, and the well-known caricaturist, Mr. H. Secretan." Messrs. B. Townsend and P. H. Rolfe responded on behalf of the artistes and the committee respectively.

During the evening three prizes were given for the winning number from the numbered programmes, drawn from a hat by the Lancashire comedian, Mr. J. Wilson. They were won, in order, by Messrs. R. D. Patrick, W. G. Blackwell, and F. B. J. Skudder.

A hearty vote of thanks was accorded to the chairman on the proposition of Mr. F. Tuck. Mr. T. Hands responded, regretting that the refreshments, although they appeared to be in sufficient quantity at the start, did not hold out. He said that they were most fortunate in having the services of such accomplished pianists as Messrs. R. Snewing and S. C. Witcombe. The talent was so good that it seems rather invidious to particularise, but mention may be made of the artistes Messrs. J. Wilson, A. Nicholls, B. Townsend, and H. Moody. The evening closed with "Auld Lang Syne" and the National Anthem.

Engineering Wages.—New overtime and night shift conditions have been accepted by the Amalgamated Engineering Union, after a ballot of the members. These establish for the first time in the history of the industry, in federated shops, uniform conditions for overtime and night shifts, and thus abolish the many anomalies that at present exist in different parts of the country. The agreement will take effect on and from the fourth full pay-day; night workers will be paid at the rate of time and a-third for 47 hours, and overtime at the rate of time and two-thirds, calculated on day shift rates. All hours between 12 midnight Saturday and 12 midnight Sunday will be paid double time.—*Daily Dispatch.*

Wages and Salaries.—A ballot to decide the acceptance or refusal of an offer of increases varying from 3s. to 12s. per week made by the Joint Industrial Council for Area No. 10, is to be taken by the E.T.U. and other unions concerned.

Mechanics' mates will receive 2s. per hour from the beginning of November under a recent agreement between the National Federated Electrical Association and the London District Committee of the E.T.U.

The threatened strike of L.C.C. tramway employés over the question of the classification of controller repairers and others as skilled operatives, has been deferred, and representatives of the Municipal Tramways Association, the Metropolitan Municipal Tramway Managers' Association, and the E.T.U. were to meet on Wednesday last, November 24th.

A meeting of the Joint Industrial Council for the Tramways Industry has been arranged for December 7th to consider the claims of tramway employés for a further increase of 12s. per week. Many undertakings have expressed their inability to accede to the demand owing to the present state of their finances.

The Hull Corporation Electricity Committee has complied with a request of the E.P.E.A. to make payment of the agreed schedule of rates for members of technical staffs. The estimated additional cost to the Corporation is £1,000 per annum.

Motormen and conductors in the employ of the Birmingham Tramways Department decided at a meeting on November 21st to press, under the threat of a strike, for the advance of 12s. a week recently applied for. There was a refusal to accept arbitration.

A conference of representatives of electric supply authorities—municipal and company—with the West Midland authorities (13 in number, in the counties of Warwick, Stafford, Salop, and Worcester) was held at Birmingham on November 22nd, Ald. Bird (Birmingham) presided. It was unanimously resolved that all electric supply authorities in the West Midlands area be strongly urged to accept in their entirety the conditions of employment and schedule of salaries for technical engineers on the staff of electric supply undertakings, as issued by the National Joint Board, and dated May 12th, 1920.

Luxemburg's Economic Future.— Under this title Mr. R. F. H. Duke, Commercial Secretary to H.M. Embassy, Brussels, gives in the *B.O.T. Journal* for November 18th a detailed account of the economic possibilities of this small but industrially important Grand Duchy. The population, formerly dominated commercially by German interests, is strongly pro-Ally, and there are already opportunities for British trade, which will increase as the rate of exchange tends to approach the normal. Inquiries from British firms should be addressed to the Commercial Secretariat at our Belgian Embassy.

Excess Profits Duty.—Concern is being caused to the Chancellor of the Exchequer by the E.P.D. yielding very much less than he anticipated. The claims for rebates are enormous owing to the fall in trade, and threaten the early approach of a time when they will equal the revenue from this source. It is probable that a conference of bankers and merchants with the Chancellor of the Exchequer and other Ministers will be held shortly to consider the position. Though the tax has been raised from 40 to 60 per cent., the yield for the six months ended September 30th was £20,000,000 *less than in the same period last year.* Arrangements have been made for a conference between the Government (represented by the Premier, Mr. Bonar Law, the Chancellor of the Exchequer, and the President of the Board of Trade), and leading bankers and traders. The Premier, accompanied by Sir Robert Horne, recently breakfasted with Mr. Peter Rylands, President of the Federation of British Industries, at 10, Downing Street. The conference referred to, which may be taken as a result of the strong case put forward by Mr. Rylands, will be held, it is understood, before the Premier addresses the Federation of British Industries at its annual dinner. Some recently established firms have, it is stated, removed out of the country because they could not stand the taxation here.

Export Credits Scheme.—The Department of Overseas Trade says the recent passage of the Overseas Trade (Credits and Insurance) Act through Parliament, and the fact that certain modifications have now been made in the export credits scheme, afford a suitable opportunity for bringing again to the notice of Chambers of Commerce and Trade Associations the facilities afforded by the Export Credits Department in relation to British trade in Central and South-Eastern Europe. Up to the present time the scheme has not been taken advantage of to a very great extent, partly owing to the fact that manufacturers and merchants in this country have enjoyed a period of unprecedented prosperity, and have had no time to consider extensions in new directions. There are now signs of reaction and consequent slackness of trade, and it is, therefore, likely that manufacturers and others will be seeking new outlets for their trade.

Under the Overseas Trade (Credits and Insurance) Act credits may be accorded up to an aggregate amount not exceeding 26 million pounds in respect of exports of British manufactured goods to the following countries: Finland, Latvia, Esthonia, Lithuania, Poland, Czecho-Slovakia, Serb-Croat-Slovene State, Rumania, Georgia, Armenia. Bulgaria has recently been added to the schedule, and other countries may possibly be included as occasion arises. Credits may be granted up to a maximum period of three years.

It should be explained that the advantages of the scheme cannot under the Act be accorded to an alien or to a firm in which the majority of the partners are aliens, or to a company in which the majority of the directors are not British subjects.

Copies of the revised conditions may be had on application to the Export Credits Department, No. 73, Basinghall Street, London, E.C. 2, where all information on the subject may be obtained. If members of any Chamber or Association wish to go into the matter further by personal discussion, the Department will endeavour to arrange for a representative to attend any meeting in order to answer questions or to explain the details of the scheme.

Commercial Travellers in Denmark.—The Commercial Secretary to H.M. Legation at Copenhagen has drawn attention to the fact that travellers visiting Denmark frequently experience difficulties through ignorance of the regulations in force with regard to the operations of commercial travellers. The Commercial Secretary has obtained from the competent Danish authorities full details of these regulations, which with certain minor exceptions, agree with those published in the Commercial Travellers' Returns 1914 (Cd. 7031). Full details of the regulations can be obtained on application to the Department of Overseas Trade.—*B.O.T. Journal.*

Ex-Enemy Patents, &c.—Two orders have been signed by the President of the Board of Trade relating to late enemy copyrights and patents. They are:—

(1) Order of the Board of Trade directing the custodian to divest himself of copyrights previously owned by German and Austrian nationals. (2) Order of the Board of Trade directing the custodian to divest himself of patents previously owned by Austrian and Bulgarian nationals.

The texts of these Orders, which are of considerable length, are published in the Illustrated Official Journal of Patents of November 17th.—*B.O.T. Journal.*

Catalogues for Brazil.—The Commercial Secretary to H.M. Embassy in Rio de Janeiro calls attention to the fact that catalogues are often sent from the United Kingdom to Brazil by parcel post, with the result that considerable delay occurs before they are handed over to the addressee. It is highly desirable that catalogues for Brazil should be sent as "registered printed matter" (*Impressos Registrados*), the maximum weight allowed for each package under this heading being 4 lb. Firms desiring to send catalogues in quantity should forward separate packages, not exceeding 4 lb. each, the total weight of a number of parcels at one time not exceeding 12 lb. If printed matter from a single sender arrives in one lot, weighing altogether 7 kilos or more, the Brazilian postal authorities send them to the parcels post section, where they are treated as parcels and are delayed in consequence.—*B.O.T. Journal.*

British Chamber of Commerce for Italy.—The D.O.T. has been informed that the British Chamber of Commerce for Italy has removed from Via Carlo Felice No. 7, Genoa, to Via Orefici No. 3, Genoa.

Trade with Australia.—A letter has been addressed to The Rt. Hon. Andrew Fisher, P.C., High Commissioner for Australia, by the Federation of British Industries with reference to the difficulties which have recently arisen with regard to the London-Australia exchange position, which is seriously endangering trade between Great Britain and Australia. The Australian exchange banks are unable at the moment to purchase documentary bills on Australia, owing to the fact that they have not the necessary resources on this side to enable them to do so. This state of affairs has arisen owing to the fact that up till recently the British Government was the sole purchaser of the staple Australian exports, and that the sums disbursed on account of these purchases were made available to the exchange banks through the Commonwealth Government. The situation has now been radically altered by the cessation of such purchases, and henceforward the money expended in this country on the purchases of Australian products will become available in the ordinary course of commerce for financing the export of British goods to Australia. Such finance, however, will not be available until the maturity of the drafts drawn on London in respect of free shipments of Australian products, with the result that for the next three or four months the Australian banks, in the absence of the Government credits on which they have in the past relied, will not have the necessary funds to meet the demands for finance of the export trade from this country to Australia, until such time as the normal flow of commerce provides credits in this country.

The Federation suggests two methods by which this unfortunate state of affairs can be remedied:—

1. By the Commonwealth Government removing the prohibition on the export of gold from Australia to Great Britain, and thus enabling the banks in Australia to export the gold necessary to meet immediate credit needs.

2. By the Commonwealth Government placing at the disposal of the Australian banks in London the considerable sums which it is understood the Australian Government has at its disposal in this country, and which it is at present withholding from their normal function of financing trade between Great Britain and Australia.

The Federation feels that the present state of affairs has been caused by the action of Governments in entering into commercial transactions. These transactions, although they may have been fully warranted at the time at which they were entered into, have on their termination created a serious trade crisis, and it is not unfair to ask that all possible steps, such as those mentioned above, should be taken to end it. The Federation, therefore, earnestly requests Mr. Fisher to bring these views to the notice of the Commonwealth Government at the earliest possible moment.

"A.W.P." Welded Steel Construction.—Among the contracts recently carried out by Messrs. Welded Construction, Ltd., was the erection of a factory at Tottenham for the Galvanising Equipment Co. The factory is a skeleton steel building with walls and partitions constructed of hollow blocks. It is 200 ft. in length, 70 ft. wide, and 27 ft. high, while the main truss has a span of 40 ft., and the wing truss on each side of the building is 15 ft. in span. While the site was being cleared and the foundations put in the H-section stanchions were cut to length and the base plates were welded on. These and the various other members were prepared at the Construction Co.'s works. The trusses were welded up in halves, conveyed to the site, erected and welded in position. A simple steel jig was made into which were dropped the various members of the truss, this being an easy and accurate method of obtaining uniformity. Cleats were welded on to the principals to hold the wooden purlins in position. There is an almost complete absence of gusset plates, and the method by which the tension member passes between the two compression members, both at the principal and at the horizontal tension member, is very interesting. The electricity was obtained from the local Supply Co., and the electrical plant consisted only of a transformer, choking coils, electrode holders, and cables. The whole of the work, in spite of delays in the delivery of materials, was completed in nine weeks.

Winding-up Petitions.—Mr. Justice P. O. Lawrence recently called attention to a growing tendency among practitioners in presenting winding-up petitions to disregard the rules applying to the advertisement of petitions. He stated that any cases of this kind coming to his notice would be held over until properly advertised, which would cause delinquents to incur the extra costs of adjournment.

Lost Working Days.—The very serious state of affairs in the Labour world is apparent from figures recently published in the *Labour Gazette*. During the month of October there were no less than 71 different labour disputes, in addition to a further 93 which were in progress at the beginning of the month. The number of persons unemployed either as a direct or indirect result of labour disputes was approximately 1,200,000; of this total the miners' strike was responsible for about 1,100,000 unemployed.

Social.—The Cardiff and power station office staffs of the South Wales Electrical Power Distribution Co., who are members of the Local Government and Public Utility Services Guild, held their first social evening of the season on Friday, November 19th. After an enjoyable tea at the Dorothy Café, High Street, Cardiff, the party proceeded to the New Theatre for the remainder of the evening. In the unavoidable absence of Mr. W. A. Chamen, general manager, and Mr. Geo. P. Tutcher, secretary, Mr. C. T. Allan, assistant manager, was the chief guest of the evening. The good feeling between the management and staff was greatly in evidence. Arrangements are in progress for further evenings of this kind during the winter.

Russian Trade.—The problem of the resumption of trading relations with Russia was discussed at a Cabinet meeting on the 18th inst. The Russian debt to this country is said to amount to 500 millions sterling. The Prime Minister announced to the House of Commons on the 18th inst. that the Government had decided that a draft agreement to carry out the July arrangements for a resumption of trade with Soviet Russia should be prepared, and it would be ready for submission to the Russian Government in a few days' time. The agreement would not be entered into until the British Government was satisfied that the undertaking given by the Soviet Government with regard to British prisoners had been carried out. The "July agreement" included stipulations that the Soviet Government should refrain from hostile actions against Britain, and from sedition in Asia, and that an exchange of all prisoners should take place.

Mr. F. A. Vanderlip, a U.S.A. banker, who reached Newcastle from Gothenburg recently, is said to have obtained a concession from the Soviet Government by which a large slice of Siberia, including the whole Peninsula of Kamchatka, an area of 400,000 sq. miles, practically passes into the possession of a financial syndicate, in which the leading American bankers are interested, for 60 years. In the next three years the Soviet Government is to buy about £600,000,000 worth of goods from Mr. Vanderlip's syndicate, to be paid for in the products of the country, including minerals and furs. The goods to be sent from the United States include electrical and other machinery, aeroplanes, locomotives, steamships, transport wagons and equipment, and other articles of all kinds.

Indian Trade Commissioner.—Mr. T. M. Ainscough, O.B.E., His Majesty's Senior Trade Commissioner in India and Ceylon, will leave London on November 25th to join the P. and O. ss. *China* at Marseilles, *en route* for Bombay. Mr. Ainscough hopes to arrive in Calcutta about December 20th, and will then take over charge of his post.

British Industries Fair, 1921.—Although practically all the floor-space at the Castle Bromwich Aerodrome, Birmingham, has been taken up, there is still some vacant, and the opportunity afforded should not be missed by British manufacturers. The Fair is distinctly different to the usual exhibitions which are opened to the general public. At these, buyers are severely handicapped by the presence of a large number of mere sight-seers, to the detriment of the business for which the affairs are organised. Only *bonâ fide* buyers receive invitations to the British Industries Fairs from the Board of Trade, ensuring a calm businesslike atmosphere conducive to successful results both to buyer and seller.

Rumanian Oil Industry.—H.M. Commercial Secretary at Bukarest has forwarded to the Department of Overseas Trade particulars of the electrical machinery and other materials which are urgently required for the reconstruction of the Rumanian oil industry. A list of the principal firms engaged in the industry has been supplied, together with a list of the goods required. The latter is a general estimate received from the Geological Institute at Bukarest, but it has not been found possible to indicate the exact requirements of each undertaking. Names of such undertakings will, however, be furnished to United Kingdom firms interested on application to the Department, 35, Old Queen Street, Westminster, S.W.1.

The following materials, &c., are required:—"Bergmann" conduits, copper wire, porcelain fittings with shade, protector, &c., for lamps, porcelain conduits, three-phase asynchronous motors, three-phase H.P. oil-cooled transformers and oil switches, three-pole switches, fusible strip, porcelain insulators, one and three-phase meters, and well-boring equipment of all kinds. The largest single item required is a 10,000-KW. turbo-generator set.

International Trade Conference.—The General Council of the International Parliamentary Conference of Commerce met in Paris, on November 22nd, under the presidency of Baron Descamps (Belgium), 16 nations being represented at the sitting.

Anglo-German Arbitral Tribunal.—It is stated by the *B.O.T. Journal* that the Mixed Arbitral Tribunal between representatives of the United Kingdom and Germany has been constituted and will shortly commence operations in London. A great part of the work will be to decide differences arising between an enemy debtor and an enemy creditor or between the British and German clearing offices. Under Article 297 of the Treaty of Versailles the Tribunal can determine compensation to be borne by Germany in respect of damage or injury inflicted upon the property, rights, or interests of British nationals in German territory as they existed on August 1st, 1914, by the war measures or measures of transfer mentioned in the Annex to the Article mentioned above.

German Magnetos.—The serious effect that the importation of German magnetos is having, even at this early date, on the British magneto industry, was recently discussed with a representative of *The Times* by Mr. D. V. L. Fellows, of the Fellows Magneto Co.

When it became apparent that the war would be of long duration Mr. Fellows approached the War Office and offered his services in connection with the supply of magnetos, for it was then obvious that, with the supply from abroad cut off, and the demand increasing every day, it was essential that magnetos should be got in large numbers from a new market.

Mr. Fellows said that he was kept waiting some hours at the War Office, and was then told that his help was not required as the War Office had plenty of magnetos. He pointed out that these supplies were all German goods—a fact of which the official interviewed apparently was not aware—but still no advantage was taken of his offer, and consequently it was with France that he made his first two contracts. Shortly afterwards some official surprise was expressed that a British firm was supplying this type of goods to foreign though Allied customers, and his firm was taken over and controlled, and asked to raise capital to form a large company with extensive works.

Then, continued Mr. Fellows, the firm was promised that after the war a ban should be put on German goods and a heavy import duty should be charged on goods from the United States of America. But the undertaking was ruled out. Since the war they had been working very hard for increased output, still expecting that this ban would be placed on magnetos of German origin. Prices meanwhile were cut to compete with the German maker, but this it would be impossible to continue doing. No doubt several smaller firms would shut down while the struggle went on.

Unemployment had reached a serious stage; one or two firms only were working full time, most working only one or two days a week. Those who were able to work full time depended, if that state of affairs was to be maintained, on shipping orders.

Mr. Fellows declared that the German manufacturer was dispatching his magnetos to this country for sale at a figure far below cost price. In his belief, the German Government was continuing its pre-war, and always successful, policy of subsidising the German manufacturer in the foreign market.

Australian Trade.—In the Federal House of Representatives, on November 22nd, Mr. Hughes introduced a Bill for the repeal of the War Precautions Act. The Government is to retain control of coal and primary products, and is given drastic powers. No foreign company can be registered, nor can aliens hold shares in Australian companies without consent. The representatives of overseas companies and firms may be required to furnish yearly the particulars of their business operations.

LIGHTING AND POWER NOTES.

Antrim.—Lighting Scheme.—Ninety-seven per cent. of the inhabitants have voted approval of an electric lighting scheme for the town. Two-and-a-half per cent. were in favour of other illuminants, while the remainder did not vote.

Batley.—Parliamentary Bill.—In the Bill which the Corporation is promoting in the ensuing session of Parliament powers are being sought, amongst other things, to enable it, so far as the electricity undertaking is concerned, to supply electricity to premises in streets not dedicated to public use, to discontinue a supply in case of breach of any agreement, to provide showrooms and exhibitions, to require notices of discontinuance of supply to be in writing, to supply or refuse to supply persons having an independent supply of power, to refuse supplies to persons indebted to it in respect of gas or electricity supply, to require consumers to pay the cost of all electric lines from any distributing main, and of all fittings in connection therewith, and to construct and maintain electrical sub-stations in or under any street not repairable by the inhabitants at large or dedicated to public use.

Birkenhead.—Proposed Extensions.—To meet the growing requirements for electricity in Birkenhead, the Corporation proposes to erect a high-pressure sub-station in Marshall Street, to install additional machinery at the Bentinck Street and Southend generating stations, and to lay mains. The work will cost £44,000, and the annual charge to the ratepayers is estimated at a total of £3,943.

Bradford.—Strike Averted.—A strike which would have cut off the electricity supply was narrowly averted on Saturday, November 20th. The enginemen and firemen found that under the new wage schedule they were paid time and a quarter for Sunday work, instead of double time, and threatened to strike at midnight on Saturday unless double time was continued till the disputed point was settled by arbitration. On Saturday night the Electricity Committee offered to pay double time for Sunday on the basis of a 56-hour week, instead of 48, and this the men accepted. *The Times.*

In connection with this strike threat a deputation of the technical staff—members of the E.P.E.A.—assured the Corporation that the unconstitutional action threatened did not meet with their approval, and they would accordingly do their best to maintain the supply.

Bury.—Loan Sanctioned.—The Electricity Committee has received the sanction of the Electricity Commissioners to the borrowing of £102,928, £74,864 being for plant and £28,064 for extension of buildings.

Dublin.—Restrictions Necessary.—The City electrical engineer has reported that requests to consumers to curtail their use of electricity on account of the coal shortage, have met with but little response. The present state of coal stocks made it imperative that compulsory restrictions should be made, as, failing this, the works would have to close down shortly. Another appeal for the reduction of consumption between the hours of 4 and 6 p.m. has been made.

Mr. Fred. Allen, the secretary of the electricity department, has again been arrested. The offices of the department were raided by the police on November 19th, and a number of books and documents were confiscated.

The re-extension of the Dublin "Curfew," under military regulation, from 12 midnight to 5 a.m., which means an additional two hours, was expected to leave more complicated the question of providing facilities for night workers and early morning workers in the matter of street lighting. The tragic occurrences of last Sunday, however, induced the Lord Mayor (Mr. L. O'Neill) to exercise his privilege, notwithstanding the Corporation order against maintaining the lighting during Curfew hours, to have all electric lights in the central districts kept on.

Falkirk.—Engineer's Salary.—At a meeting of the Town Council last week, the Town Clerk read a letter from the hon. secretary of the Associated Municipal Electrical Engineers, making application on behalf of the electrical engineer for payment to him of the Association scale of salary and bonus. The Town Clerk was instructed to communicate with the municipal authorities in Scotland having electricity undertakings as to salaries being paid to chief engineers and staffs, and as to the capacity of their works.

Glasgow.—Steam Pipe Explosion.—An explosion, caused by a flange of a steam pipe giving way, took place on Thursday night last week, at the Corporation power station at Port Dundas. The night shift men on duty escaped injury, and soon repaired the damage, but for a time the mishap caused a diminution of light in various parts of the city.

India.—New Developments.—A number of new schemes for supplying electricity to districts are under consideration. Multan, Rawalpindi, Lyallpur, Jullundur, Sialkot, and Gujranwala are mentioned by the *Times of India* as places where electricity schemes are being discussed. A body, with the title of Punjab Hydro-Electric and Industries Association, has been formed to, *inter alia*, develop power from four canal falls in separate linked-up schemes. Electricity will be supplied from this system to a considerable area of the country, mainly north of the Chenab River. Preliminary inquiries are progressing in the matter of generating power near Kiratpur by a tunnel from the Sutlej River. This scheme aims at supplying power to a large district between the Chenab and Jumna Rivers.

Strike Settled.—The Bombay cotton mill hands have resumed work, says *The Times*, and the tramway strikers were expected to return to work on Sunday last. The postal and telegraph workers have been told that their places will be filled if they do not return to work immediately.

Invergordon.—Electricity Supply.—Arrangements have been made for a supply of electricity to the district by means of overhead mains from the Admiralty power station.

Inverness.—Hydro-Electric Scheme.—A Provisional Order is being applied for by the Grampian Electricity Supply to use water power to secure electricity for all purposes. Reservoirs and aqueducts will be constructed, pipe lines laid, and roads made. Lochs Ericht, Pattack, and other lakes, are to be taken possession of. Electricity will be distributed over an area in Inverness-shire, Perthshire, Kinross, and Forfar, and also certain parishes in Stirlingshire.

Japan.—Electricity Supply.—The electricity supply industry in Japan is chiefly in the hands of private companies, and it is stated that a total of 1,100,000,000 yen is invested in this direction. The amount of new capital required each year is about 100,000,000 yen, but difficulty is experienced in obtaining this, as

Japanese financiers are not content with a return of less than 12 per cent. The price of electricity in the country is at about the same level as abroad, but the lack of any schemes for more economical production of power, such as are in hand in other countries, will not tend to decrease charges. The greater part of Japan's electricity is produced by means of water power, and concessions of falls, &c., have consequently become valuable, and are frequently secured for merely speculative purposes, leading to delay in the construction of new plants. The question of railway electrification has been postponed, as it is stated that a national power station would be required for the scheme.

Leith.—ELECTRICITY IN DOCKS.—Electric cranes are being erected at the docks, and other electrical work carried out by the Leith Dock Commission.

Littleborough.—LOAN.—The Council is applying for sanction to borrow £16,000 for the provision of high-tension cables to Spenwood Mill, Python Mill, and the Hare Hill Woollen Mills, together with the necessary transformers and switchgear, including additional service cables which may be necessary in the near future.

Liverpool.—DOCK ELECTRIFICATION.—The engineer to the Mersey Docks and Harbour Board reports, with reference to the scheme for the electrification of part of the dock estate, that the laying of the main cables for the Hornby, to Sandon Dock Section of the work, the contract for which was placed with Messrs. Callender's Cable and Construction Co., Ltd., is now practically comp'eted. The building of the Canada Dock sub-station is completed with the exception of the asphalting of the floors. The Dock Board has decided to proceed with the work for the electrification of the Gladstone Docks, and contracts for main cables, switch gear, converters, &c., have been placed with the various contractors for the Hornby to Sandon Dock section.

Mansfield.—LOAN.—The Town Council is applying for powers to borrow £12,000—the cost of laying mains to the Bull Farm housing site. A sum of £30,000 is being spent on extensions, and a loss on the year's working is anticipated, as the extensions will not be revenue-producing until the next period.

Mosley Common.—FIRE.—The power station at the Earl of Ellesmere's collieries was damaged by an outbreak of fire last week. The building itself did not suffer much, but serious damage was done to some of the valuable plant which supplies practically the whole of the firm's collieries with power for pumping, haulage and lighting.

North-East Lancs.—ELECTRICITY DISTRICTS.—Preparatory to conferring with the Electricity Commissioners in London, on December 1st, the North-East Lancashire group of the Mid-Lancashire section of electrical undertakings held a conference at Burnley on November 18th. The business had reference to future policy, and it was understood that the delegates would not agree to accept any financial responsibility for the working of a group in Mid-Lancashire.

Paisley.—YEAR'S WORKING.—The accounts of the electricity supply undertaking for the year ended May 15th last show a total revenue from all sources of £64,254, while against this there was a total expenditure of £42,699. Of the gross balance of £21,555, £21,029 was absorbed in payment of capital charges, leaving a net profit for the year of £746.

Portarlington.—PURCHASE OF UNDERTAKING. — Mr. P. J. Weymes, a county councillor, Mullingar, has purchased the Portarlington electric light works.

Slaithwaite.—ELECTRICITY SUPPLY.—The Urban District Council is at present negotiating with an outside authority for the supply of electricity to the district. Having considered the proposals of the Huddersfield Corporation and the Electrical Distribution of Yorkshire, Ltd., the Urban District Council has decided to inform the company that the Council will be prepared to apply to the Electricity Commissioners for consent to transfer to the company all its powers under the Slaithwaite Electric Lighting Provisional Order, subject to the latter agreeing to the following conditions :—(1) That the distributing mains be underground ; (2) that the company guarantee the supply by October next ; (3) that the scale of charges made in the Slaithwaite area shall not exceed the average rate of charges made by the company in the whole of the area supplied by it. A representative of the company is to be asked to meet the Council to discuss the proposed site of the transformer station and other matters.

Warwick.—SUPPLY CHARGES.—The Warwick Chamber of Trade has decided to ask the Ministry of Transport to hold a public inquiry into the proposal of the local Electricity Supply Co. to raise the charges for electricity.

Windsor.—TANK ENGINE.—During the coal strike it was thought that the engine of a tank, recently presented to the Town Council, would be useful to the Slough Electric Light Co., to enable it to continue the supply of electricity. The engine was accordingly sold to an official of the company by a Councillor and the borough surveyor for the sum of £20 ! Great indignation was expressed by the Council at a subsequent meeting, and it was then agreed that the engine should be returned, and the money paid for it refunded.

TRAMWAY AND RAILWAY NOTES.

Barrow.—ACCIDENT.—As a tramcar was approaching Furness Abbey terminus without passengers on November 20th, the driver fainted and fell on the platform. The car went uncontrolled 50 yards past the end of the rails and then ran into a wall. The driver was picked up insensible, but practically unhurt, and the conductor also escaped injury.

Bradford.—RAILLESS SYSTEM.—One of the provisos of the Corporation enlargement scheme with respect to the taking into the borough of the township of Denholme, is that a railless electric traction system shall be provided between Keelham and the centre of Denholme within a period of three years after incorporation.

ACCIDENT.—Owing to the fog on Saturday last a Corporation tramcar and a heavy motor-lorry collided on the Leeds and Bradford road, near Farsley. The vehicles were so badly damaged that tramway traffic was stopped for several hours. The motor driver and the tramcar driver were both injured, but not seriously.

Durham County. — TRANSPORT SCHEME. — Durham County Council, at its meeting on the 10th inst., discussed the important scheme for services of tramcars, railless trolley vehicles, and motor-'buses to which we have already referred. The proposal before the meeting was that a Bill should be promoted in Parliament to obtain powers to construct the tramways and carry out the other parts of the scheme.

The details of the proposed Bill are as follow :—

1. To empower the Council to construct tramways along a number of routes, and to authorise the Council to work such tramways and any other tramways for the time being belonging to the Council.

2. To empower the Council to provide and work mechanically-propelled vehicles adapted for use upon roads and moved by electrical power supplied by means of overhead conductors along several routes.

3. To empower the Council to provide and run motor-omnibuses on any route in the County of Durham with the consent of the local authority and road authority.

4. To authorise the Council to enter into agreements with local authorities, companies, and persons owning tramways or light railways, with which the tramways of the Council may join, authorising the Council to purchase or take leases of and work such tramways or light railways and to empower the Council to run cars over such tramways or light railways.

5. To empower the Council to make certain road and street improvements in connection with the running of the tramways, trolley vehicles, and motor-omnibuses, and to purchase compulsorily the necessary lands therefor.

6. To enable the Council to purchase lands compulsorily for the purpose of widening certain highways in the county for general traffic purposes.

Councillor Lee, the chairman, explained that if they wished to do anything in the matter, it was necessary to have an absolute majority of the Council. He added that since the Council made a move the omnibus companies had been very much alive ; they had been trying by private enterprise to cover the whole of the county, so that they might be in a position to say that the County Council scheme was unnecessary.

Mr. John Wallace moved the resolution, and stated that there was no great opposition so far as the various municipalities were concerned. He said it was impossible at present to estimate the cost. They would do the work by stages. The first portion would be the linking-up of the road from Low Fell to Durham—connecting up with the Gateshead system.

After discussion the resolution was adopted. This year, for the first time, the Labour representatives on the County Council are in a majority. Mr. Lee, the chairman, is a miners' official.

Edinburgh.—ELECTRIFICATION.—The Corporation Tramway Committee is considering the question of electrifying the tramway system from Pilrig to Prince's Street.

Grimsby. — RAILLESS CARS. — The Town Council is promoting in the ensuing session of Parliament a Bill which provides, amongst other things, for the running of motor omnibuses and railless trolley-cars in certain localities.

Halifax.—YEAR'S WORKING.—The total revenue from the Corporation tramways for the year ended March 31st amounted to £189,186, as compared with £149,827 in the previous year. Working expenses totalled £162,892, against £111,757, leaving a gross balance of £26,294 (£38,070). Payment of income-tax, loan interest, &c., resulted in a net profit of £1,476, a large decrease from the profit for 1918-19, which was £10,767.

NEW ROUTE.—The work of laying the tramway lines from West Vale to Stainland has made rapid progress during the recent fine weather, and it is anticipated that before long cars will be running to Holywell Green, which is higher up the hill than the railway station of Stainland.

Leeds.—TRAMWAY LOSSES.—An average deficit of £39 per day is reported on the working of the tramways between October 1st and October 27th, in spite of the fact that traffic and sundry revenue receipts amounted to £75,595—an increase of £11,009 over the same period last year. From April 1st to October 27th the average daily deficit is stated to be £121.

Liverpool.—Financial Position.—Last year there was a profit of over £63,000 from the Corporation tramways, but now there is a deficit of £3,694, and as no provision has been made for depreciation or reserve, which will require approximately another £140,000, this will make a total deficit of about £144,000. The chairman of the Tramways Committee explained at a recent meeting that the cost of labour had increased 260 per cent., and materials 370 per cent., whereas the revenue had only increased 104 per cent., so that the fares and stages would need consideration in the near future. There was also an arbitration with regard to a large increase of wages for tramway employés. There would be a large expenditure in connection with the reconstruction of rolling stock, and there was also to be considered the proposed new works on the Edge Lane site.

London.—New L.C.C. Tramcars.—It is proposed by the London County Council Highways Committee that 125 new tramcars should be purchased, at an estimated cost of £548,000. The first batch of 50 cars will cost approximately £4,305 each, and the remaining 75 about £4,326 each. The pre-war cost of a similar type, based on orders placed in 1910, was £883. It is anticipated that the first car will be delivered in 42 weeks. The Committee also recommends the extension of the central car-repair depôt at Woolwich, for which £185,000 will be required in the current financial year.—*Daily Telegraph.*

Walsall.—Fare Increase. — The Corporation has decided to increase the tramcar and 'bus fares. The minimum fare for the tramcars will be 2d., as compared with 1d. 12 months ago, but the percentage increase on the longer distances will not be so great. It is anticipated that if the existing fares were kept in force, there would be an annual loss of £17,000.

TELEGRAPH AND TELEPHONE NOTES.

Germany.—New Cable.—The Western Union Cable Co. announces the completion of arrangements with the German Telegraph Administration for the handling of cable traffic between Germany and the United States. It is understood that plans are under way for laying a direct cable to Germany.—*Reuter's Trade Service* (New York and Washington).

Wireless Telegraphy.—According to the Department of Overseas Trade, it is officially announced, says the *Berliner Tageblatt* that the German wireless system is to be divided into three distinct systems, viz., the international, home, and the special systems. The international system will consist of the overseas service, which will be transmitted by the large stations of Mauen and Eilvese, and the European service the messages for which will be forwarded by the central station at Konigs-Wusterhausen. The home communications will be sent by what is actually the German wireless system (Reichsfunknetz), and which is comprised at present of 15 wireless stations. The 13 existing coast stations will serve for communications to and from ships at sea. The special wireless system is very extensive; it includes: (1) The daily European and overseas newspaper service; (2) the wireless Press service, which is at present in process of formation, and by means of which a message sent by one station will be received simultaneously by a large number of receiving stations in Germany; (3) the wireless industrial service for the circulation of industrial and financial reports which is also in course of preparation; (4) the wireless services for the transmission of time signals, warnings of storms for ships at sea, and all other important reports for ships at sea, of weather reports, wireless communications with aeroplanes, &c., including postal aeroplanes; and (5) the receiving stations for receiving foreign Press reports.

Italy.—New Cable.—A submarine cable has recently been laid between Rome and Genoa in order to ensure telegraphic communication with North Italy in the event of disturbance of the land telegraph by the elements, says the *Economic Review*, quoting *Sole*.

United States.—Cable Tolls.—The controversy between the State department and the Western Union Telegraph Co. has reached the stage of an open breach, the company refusing to handle further cable messages for the department except upon prepayment of the tolls. Questions now before the International Communications Conference are said to be playing a part in the controversy. The negotiations begun by the American Government to obtain one of the former German trans-Atlantic cables now held by Great Britain, and thus open up direct communication between the United States and Germany, are said to have reached a successful termination, and to depend for final fruition only upon the willingness of an American cable company to exchange one of its lines for the former German line from Halifax to Penzance.

It is understood that the State department was negotiating with the Western Union Cable Co. for the exchange of cables, but the negotiations were broken off as the result of differences between the State department and the company. The exact point of dispute over the department's cable bills, which have not been paid since August, 1919, refers to the 50 per cent. reduction formerly allowed on Government cablegrams, which the company has discontinued owing, it says, to war-time congestion. A report reached the Government last week that the Western Union Cable Co. would make another attempt to land the Barbados cable at Miami, and Mr. Daniels, the Secretary for the Navy, ordered the Commandant of the Naval Station at Key West to take the necessary steps to prevent it. The Western Union Cable Co., however, denies that it had any intention of taking such action.—*Reuter's Trade Service* (Washington).

The Western Union Cable Co. has applied to the Supreme Court of the District of Columbia for an injunction to restrain Mr. Daniels, Secretary of the Navy, from interfering with the construction of a telegraph cable between Miami (Florida) and Miami Beach.

The Court is also asked to instruct Mr. Daniels's subordinates to cease threatening to destroy the cable if laid. This is a different cable from that which was forbidden to be laid some months ago.

Wireless Telegraphy.—High Speed Automatic Transcription.—Many thousands of words are daily being wirelessed from the Marconi station temporarily installed at Geneva for the special use of journalists attending the Conference of the League of Nations; over ten thousand words being handled on the day of the first sitting. It is only a month since the Swiss Government discussed with the wireless experts the possibility of supplementing the existing communications with foreign countries. Rapid automatic transmission is being employed, the train of signals, which cannot be understood aurally without special apparatus, being received at the British station at Witham, Essex, on rapidly revolving phonograph records. From Witham the signals are retransmitted by Creed high-speed gear to London. This is the first occasion upon which the newspaper world has had at its disposal a channel of rapid communication in which Press messages have priority over ordinary commercial traffic.

Instruments have been designed by which it is possible, after messages have been punched on tapes in the Morse code in the ordinary way, to transmit them by wireless to the receiving machine which automatically transcribes the Morse signals into Roman print characters. The process is somewhat similar to that used for the transmission of long telegraphic messages, and the main difficulty in using it with wireless has been to magnify the feeble electric waves sufficiently to work the receiving instrument. This result has been achieved by the work of Mr. F. G. Creed, of the firm of Creed & Co., Ltd., Croydon. The invention is now past the experimental stage, although it has not yet been sufficiently perfected to be publicly used. In experiments carried out at Aldershot messages were received at the rate of 100 words a minute from varying distances. The farthest point from which they were sent was Cologne. Nearly all of them appeared correctly printed at this end, but one or two were interrupted for a few words by atmospheric disturbances. Mr. Creed demonstrated his apparatus before the Royal Society of Arts on the 17th inst.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia.—Melbourne.—February 24th. Electricity Commissioners. Plant for the Morwell power scheme—25,000-12,500-kw. turbo-alternators, 600-kw. turbo-alternators condensing plant, circulating pumps, transformers, and switchgear, copper cable, transmission steel towers, &c. (See this issue.)

Tasmania.—December 13th. P.M.G.'s Department. Instrument parts, schedule T 301. (November 12th.)

Queensland.—P.M.G.'s Department. Testing and telegraph instruments (schedule 517). (November 12th.)

Aylesbury.—Town Council. Enfield Ediswan Cable Co., Ltd., steel cable, £180.

Batley.—Batley Co-operative Society. Electric lighting installation at Field Lane Store for the Secretary.

Belgium. — Antwerp, December 16th. — Municipal Council. Armoured cable terminal and junction boxes, automatic cut-outs, &c., for use at the Antwerp Dock. The specification in French can be consulted on application to the Department of Overseas Trade, 35, Old Queen Street, up to November 30th, after which date it will be available for loan to firms who are unable to send representatives to consult it at the Department.

Canterbury.—December 6th. Electricity Department. Extra-high-pressure and medium pressure D.C. switchgear and cable connections to the same. (November 19th.)

Grimsby. — November 29th. Electricity Department. Sub-station converting plant, traction converting plant, comprising one 250-kw. and one 500-kw. converter, and one 250/300 kw. converter. (November 12th.)

Leeds. — December 13th. Electricity Department. Three-phase switchgear for the generating station. (November 12th.)

Littleborough.—December 20th. Urban District Council Electricity Department.—High-tension cables, roadwork, &c. (See this issue.)

London.— St. Marylebone.—December 6th. Electricity Department. L.T. and E.H.T. lead-covered paper-insulated cable, for 12 months. (See this issue.)

Monte Video.—January 14th. Management of the Usinas Electricàs de Monte Video. Steam turbo-alternator of 10,000 kw. with the steam piping and cables; surface condenser with pumps, &c. Copy of conditions and specification (in Spanish) may be seen at the Department of Overseas Trade (Mr. Holloway) up to December 4th, after which date it may be borrowed by British firms.

Plymouth.—November 30th. Electricity Department. H.T. and E.H.T. switchgear; oil-cooled transformers. (November 12th.)

Rhodesia.—Salisbury.—January 13th. Municipal Council. Electric generating plant, switchgear, cable and converters. Specification (£3 3s.) from the Council's Consulting Engineer, Royal Chambers, Johannesburg.

Stockton-on-Tees.—December 7th. Electricity Department. Underground tramway cable (various lengths), single and three core. (See this issue.)

Wakefield.—December 2nd. West Riding Education Committee. Electrical work (alteration from private supply to public supply), motors, switchboard, wiring, &c., at the Training College, Bingley. (See this issue.)

Wallasey.—December 14th. Corporation Gas Department.—Four electrically-operated capstans. Mr. J. H. Crowther, Gas Works, Limekiln Lane.

Whitehaven.—December 1st. Electricity Supply Department. One D.C. turbo-alternator and condensing plant. (November 19th.)

Wrexham.—Electric lighting and heating of 118 houses on the Acton Park Estate. Mr. G. Douglas-Cox, borough electrical engineer.

CLOSED.

London.—L.C.C. Highways Committee. Tenders for 125 car bodies:—

	Class E 1 type, existing standard, each.	Class E 2 type, modified alternative, each.
Hurst, Nelson & Co., Ltd. .. .	£2,230	£2,430
Brush Electrical Engineering Co., Ltd.	2,245	2,455
English Electric Co., Ltd.	2,555	2,705

125 sets of swing bolster trucks:—

Hurst, Nelson & Co., Ltd. (recommended)	**£600** a set
Brush Electrical Engineering Co., Ltd.	630
Heenan & Froude, Ltd.	836 10s
Baldwin's Locomotive Works, U.S.A.	£4,320 (about £1,202)

125 sets of electrical equipment, &c.:—

Metropolitan-Vickers Electrical Co., Ltd. ..	£1,300 10s. a set
English Electric Co., Ltd.	1,306 10s.
British Thomson-Houston Co., Ltd.	1,942 10s.

Magnetic brakes for 125 new cars:—

Metropolitan-Vickers Electrical Co., Ltd. (recommended) **£21,875**

The Highways Committee reports that no tender contained a firm offer on the basis of fixed prices, so that it will not be possible to accurately determine the ultimate cost of the cars until the contracts are fulfilled. Each of the tenders which the Committee proposes to accept provides for variations in cost, both upwards and downwards, the present-day prices as quoted being taken as a datum line.

The Committee proposes to accept the lowest tender for 50 car-bodies of the Class E 1 type at £2,230 each, and the second lowest for 75 bodies at £2,245 each. As regards the tenders for electrical equipment, in order to afford an opportunity of testing the motors offered by each company under actual running conditions, it is proposed to divide the contract between the companies submitting the two lowest tenders, viz., 50 sets to be ordered from the Metropolitan-Vickers Electrical Co., Ltd, at £1,300 10s. a set, and 75 sets from the English Electric Co. at £1,306 10s. per set. On the basis set out above, the cost of the first 50 cars is estimated at £4,305 10s. each, and that of the remaining 75 cars at £4,326 10s. each. The comparative cost of a similar type of car based on orders placed in 1910 was £884. It is anticipated that the first new car will be delivered in 42 weeks from the date of the order, and that cars will be completed at the rate of six per week for the first 100 cars, and at the rate of three per week for the remaining 25 cars.

St. Marylebone.—Electricity Supply Committee.

Two additional cable panels with protective devices and cable screens for Aybrook sub-station; and three truck-type interlocking cubicles, for installation at Messrs. Selfridge's premises, £1,597.—**Ferguson and Pailin, Ltd.** (recommended).

Steelwork for foundations for the turbo-alternator, crane track, &c.—

Sanders & Foster, Ltd. (recommended) **£3,740**

Motors for induced-draught fans—

W. H. Allen, Son & Co., Ltd. (recommended)	**£1,160**
Crompton & Co., Ltd.	1,284
Industrial Electro-Plant Co., Ltd.	1,499
Metropolitan-Vickers Electrical Co., Ltd.	1,603

Extra tappings on transformers for the three rotary converter sets, £101.—**Metropolitan-Vickers Electrical Co., Ltd.** (recommended).

Two exciters, rheostats and supporting stools to provide for the inverted running of two of the existing 1,000-kw. rotary converters, at Aybrook Street, £556.—**Metropolitan-Vickers Electrical Co., Ltd.** (recommended).

Sweden.—The Stockholm Tramway Co. has decided to purchase 50 motor tramcars from the Allgemeine Elektrizitaets Gesellschaft and the Aktiengesellschaft Siemens-Schuckert. Of all the offers received, which included proposals from Swedish and American firms, the German ones were most favourable as regards date of delivery.—*Reuter's Trade Service* (Stockholm).

FORTHCOMING EVENTS.

Physical and Optical Societies.—Friday, November 26th. At the Imperial College of Science and Technology, South Kensington, S.W. At 7 p.m. Joint discussion on "The Making of Reflecting Surfaces."

Junior Institution of Engineers.—Friday, November 26th. At Caxton Hall. At 8 p.m. Lecturette on "Reinforced Concrete Coal Bunkers and Silos," by Mr. C. O. Mourant.

Friday, December 3rd. At 8 p.m. Lecturette on "Electrolysis as Applied to Measurement of Water," by Mr. G. F. Shotter.

Manchester Association of Engineers.—Saturday, November 27th. At the Memorial Hall, Albert Square. At 7 p.m. Paper on "Modern Developments in the Manufacture and Utilisation of Coal Gas," by Mr. F. J. West and Mr. J. A. Tomlinson.

Institution of Electrical Engineers.—Monday, November 29th. Informal meeting. At the Institute of Patent Agents, Staple Inn Buildings, W.C. At 7 p.m. Discussion on "Electrical Transmission on Petrol Vehicles," to be opened by Mr. A. F. Harmer.

Thursday, December 2nd. At the Institution of Civil Engineers, Great George Street, S.W. At 6 p.m. Special general meeting.

(**Students' Section**).—Friday, December 3rd. At King's College, Strand, W.C. At 6.30 p.m. Discussion on "The Modern Tendency to Trusts: Is it Beneficial?" to be opened by Mr. A. Serner.

(**South-Midland Centre (Students' Section**).—Tuesday, November 30th. At the University, Birmingham. At 7.30 p.m. Paper on "X-Rays and their Application in Engineering," by Mr. S. Payman.

(**North-Midland Centre**) (**Sheffield and District Sub-Centre**).—Tuesday, November 30th. At the Royal Victoria Hotel, Sheffield. At 7.30 p.m. Chairman's speech. Smoking concert.

Institution of Civil Engineers.—Tuesday, November 30th. At the Institute, Great George Street, S.W. At 5.30 p.m. Ordinary meeting.

International Advertising Exhibition.—White City, Shepherd's Bush, W. November 29th to December 4th.

Royal Society of Arts.—Monday, November 29th. At John Street, Adelphi, W.C. At 8 p.m. Cantor lecture on "Micro-organisms and some of their Industrial Uses," by Mr. A. C. Chapman, F.R.S.

Paisley Association of Electrical Engineers.—Wednesday, December 1st. At the Technical College, George Street. At 7.30 p.m. Paper on "Armature Winding," by Mr. W. R. Scott.

Chemical Society.—Thursday, December 2nd. At Burlington House, Piccadilly, W. At 8 p.m. Ordinary meeting.

Chelmsford Engineering Society.—Thursday, December 2nd. At 7 p.m. At the East Anglian Institute of Agriculture. Paper on "Diesel Engines," by Mr. G. Bass.

Institution of Mechanical Engineers.—Friday, December 3rd. At 6 p.m. Further discussion on the paper by Mr. A. Ramsay on "The Human Factor in Industry."

Edinburgh Electrical Society.—Friday, December 3rd. At the Philosophical Institute. At 8 p.m. Paper on "An Electrical Engineer's Walk Round a Factory," by Mr. J. Walker.

NOTES.

The New Radiology.—Surely the Barber of the "Thousand and One Nights" never had a more brilliant inspiration than that which recently occurred to a modern "Knight of the Brush." According to the *Times* report of a recent prosecution, a young man entered a barber's shop for a shave. The barber, who was, no doubt, something of a scientist, persuaded his client that treatment of the skin by "violet rays" was what he really required, and, having secured consent, rubbed a violet electric lamp over the young man's face, charging him the modest fee of £5. (True science was ever ill-paid!) Reluctant to leave a job but half completed, the barber then informed his victim that the charge for a course of the treatment was £10, an amount for which a cheque was promptly handed over. Later, however, suspicions must have arisen in the young man's mind, for he stopped the cheque.

Electric Coal-Cutters Banned.—A Committee appointed by the Minister of Mines to report upon the safety of the coal-cutting machines at the Mount Kembla (N.S.W.) Colliery, has presented a report adverse to the use of these machines. The evidence of a number of employés pointed to frequent "flashing and sparking" from the motors of the cutters, although no report of the occurrences has been received in official quarters. The Committee's final decision, having due regard to the probability of exaggeration on the part of employés giving evidence, was that the continued use of these cutters was not consonant with the safety of the workers. The Committee expressed its regret that machinery which materially increased production could not be used with absolute safety.

Fatalities.—An inquest was held, on November 20th, on the death of Arthur Townend (59), loom tuner, in the employ of C. & J. Hirst, Sunnybrook Mills, Longwood, near Huddersfield, which took place the previous Thursday from electric shock. Townend was working on a loom which had become charged with electricity owing to a leakage which had not been detected. The loom was adjacent to an iron girder, and one of Townend's clogs came into contact with it; he received a shock at 225 volts A.C. A verdict of "Accidental death" was recorded.

Alex. Wilson (21), an Edinburgh steel worker, was struck by the jib of a crane at the new electric power station at Portobello, Edinburgh, and killed.

Radiography in Industry.—At a meeting of the Birmingham Business Club, this week, Major J. Hall-Edwards again put forward the importance of the radiography of materials used in industry. He emphasised that the application of X-rays to industry was a matter in which business men should take an interest; among the uses to which X-rays could be put were, according to the *Birmingham Post*, the detection of blow holes and cracks in metals up to a thickness of 6 in., and the inspection of the interior of such things as flash lamps, electric cables, &c., also came within the range of the apparatus. The carrying out of large experiments likely to benefit manufacturers, said Major Hall-Edwards, would entail the installation of an expensive apparatus and of skilled workers. He felt that Birmingham should possess an X-rays laboratory, and made a plea for the establishment of such a laboratory that might become a branch of the Birmingham University, and the research work done there under the guidance of the professors. They should bear in mind that up to the present the application of radiography in the examination of materials had only just reached beyond the experimental stage. It was quite possible they might have at their disposal before very long apparatus very much more powerful than any which was necessary for experiments in the realms of medicine and surgery. It had been suggested by Mr. A. A. Campbell Swinton that it might be possible to make an X-ray tube of metal perhaps a foot or two in diameter, which would be able to carry a large amount of current. Such a tube was quite within the scope of practical engineers.

Theft of Fittings.—At Manchester County Police Court last week, Ralph Leslie Allen (20), of Cheetham, pleaded guilty to stealing a number of electric lamps and fittings to the value of £50, the property of Messrs. Massey & Harris, Ltd., Old Trafford. Allen was formerly employed as a wireman by a firm of electrical engineers in Hulme, but was discharged in November, after which the goods were missed. Evidence of buying various fittings from the prisoner during the period between November and July was given by William Osborne, an electrical engineer, of Salford, who said he had been dealing with Allen for five years, and understood the goods to be surplus materials left over from Allen doing jobs in his spare time. Allen was sentenced to six months' imprisonment with hard labour, and the chairman also intimated that Osborne would not be allowed witness's costs as the Bench considered he had not been as careful as he might have been in his transactions with the accused.

The Debt of Honour.—Speaking at a recent meeting, Lord Haig again championed the cause of unemployed ex-Service men. He said it was a great shame that these men after their war service could not obtain work because they had not served apprenticeships. In another direction, he said that during the war great sums of money were raised by war loans, and now the interest was being regularly paid. On the other hand, ex-Service men were unable to find employment. He (Lord Haig) could see no difference in the nation's treatment of these men and the repudiation of all war loans, and refusal to pay the interest. The response to his appeals during the past 12 months had not been entirely satisfactory, and he urged his audience to help pay the nation's debt—not looking at it as a matter of charity, but as just payment for services rendered, lives given, and wounds received.

It is stated that the number of employers on the King's National Roll up to November 10th was 22,328.

Ex-Officers' Training.—The Officers' Association and the Appointments Branch of the Ministry of Labour have come to an arrangement whereby five hundred business men will be requested to serve on "panels" in London to inquire into the capabilities of applicants for employment. The "panels" will sit for a fortnight before Christmas and a fortnight afterwards. The idea of this scheme is to avoid overlapping between the Association and the Ministry of Labour. The Appointments Branch states that now that the State offers to maintain an ex-officer or service man for a period of 12 months, it is thought that business men will be able to train a man and at the end of the period engage him at a fair salary to carry on with the work. Directors of companies and others in similar positions are asked to further the scheme by notifying suitable vacancies to the Ministry of Labour or by serving on one of the selection "panels."

New Electroplating Process.—The discovery of a new process in electroplating has been made by Mr. Frank Mason, A.M.I.E.E., and was made public on November 19th at the joint meeting of the Faraday Society and the Sheffield Section of the Institute of Metals. Mr. Mason is well known as a lecturer at Sheffield University, as well as a practical works manager. During the war period he conducted researches in electrometallurgy and electrochemistry on behalf of the Ministry of Munitions, and his discovery is the sequel to well-ordered observations and experiments on given lines. The process, to which no patent rights are attached, as it has been worked out entirely in the Sheffield University electrometallurgical laboratory, and is given out as from the University, is said to have given in actual workshop practice over 100 per cent. increased productivity from the vats; it permits of the use of a much larger electric current than usual in the baths, and, therefore, forms the deposit more quickly, while at the same time the "plate" resulting is of the best quality. According to the *Sheffield Independent*, it is ordinarily accepted that when potassium carbonate reaches a certain percentage in the plating bath it is advisable to add barium cyanide to eliminate the potassium carbonate. Instead of following this rule, however, Mr. Mason in his new process adds a further percentage of the latter by direct application, and in conflict with the old theory and practice. The experiments showed that in an electrolytic bath containing a 10 per cent. compound of potassium carbonate, with the electric current normal, a fine and reguline deposit of silver plate on copper resulted; but when the current was increased to 6 amps., compared with the present 4 amps. in present plating practice, although the deposit was rapid it was large and crystalline and a "finish" could not be got on it. When, however, the bath solutions contained a higher percentage of potassium cyanide in conjunction with potassium carbonate, this undesirable effect was somewhat counteracted. Mr. Mason found that with a free cyanide content far in excess of that advised or suggested in any up-to-date text books, and with potassium carbonate in quantities probably little dreamed of by the authors, not only could the current density in the plating bath be increased enormously, and the plating be done more quickly as a consequence, but that the deposit of "plate" (silver) was of a finer texture altogether, and equal to, or better than in the ordinary plating process in use.

Appointments Vacant.—Shift charge engineer (£293), for the Borough of Leigh (Lancs.) Electricity Department; telegraph engineers (£480), for the Governments of the Gold Coast and Nigeria. See our "Official Notices" to-day.

Lecture Note.—A lecture, entitled the "History of an Invention," was delivered by Mr. L. W. Wild, M.I.E.E., before the Camera Club, on the 18th inst., with the aid of slides illustrating the inception and development of the Wild-Barfield electric furnace. Micrographic sections of steels subjected to various heat treatments were also illustrated.

A Crisis in Electricity Supply.—The following letter has come to hand as we go to press:—

"I beg to express my great appreciation of the leading article in your last issue, under the above heading. Your unqualified support of the spirit of 'Whitleyism,' and your obviously sincere desire to see the findings of the National Joint Board honourably upheld throughout our industry, will undoubtedly be most gratifying to all grades of the technical and commercial staffs represented on the Board.

"The prolonged delay, and in some cases, the absolute refusal, by many of the supply authorities to give effect to agreements between their representatives and the staff organisations, had not only precipitated a crisis so far as the E.P.E.A. is concerned, but are rapidly bringing about a similar condition in the commercial and clerical staffs, which are organised in the Electricity Supply Commercial Association.

"The representatives of the E.S.C.A. on the National Joint Board unanimously supported the adoption of the E.P.E.A. schedule of salaries on May 12th last, and on the same date the representatives of the E.P.E.A. unanimously supported the adoption of the E.S.C.A. scale of bonus. In each instance the employers' representatives were also unanimous, after considerable concessions on the original claims had been made by both Associations.

"In the six months that have since elapsed each Association has expended an appalling amount of time and money in endeavouring to persuade the defaulting municipal and company authorities to honour agreements made on their behalf. If, amongst the technical and commercial staffs, these authorities found as low a code of honour as that now practised by themselves, the industry would be quickly ruined, and loyal and efficient service unknown.

"I believe that a larger number of undertakings have rejected the E.S.C.A. scale of bonus than have rejected the E.P.E.A. schedule. Your article states that a man with a pre-war salary of £200 a year should now be paid £500 'merely to maintain his original position.' You are certainly not erring on the generous side, but what legitimate objection can be advanced against paying that man a wretched £360, which is all that the E.S.C.A. scale of bonus entitles him to?

"I am somewhat mystified as to why the E.P.E.A. and the E.S.C.A. are not taking concerted—or even joint—action in this matter. The E.P.E.A. is admittedly in a strong position, on account of the nature of its members' duties, but the possibility of a coincident disorganisation of the business side of the industry would further strengthen the E.P.E.A. position very considerably. No better opportunity will present itself for not only forcing the defaulting authorities to act honourably, but also for firmly establishing the prestige of the E.S.C.A., the E.P.E.A., and the National Joint Board.

"SUSSEX.

"November 24th, 1920."

Educational.—The Secretary of State for the Colonies has appointed a Committee, under the chairmanship of the Right Hon. Lord Chalmers, G.C.B., to consider and report what steps can be taken to secure the assistance of the Universities of this country in carrying out the research work which is essential to the protection of the inhabitants of the Colonies and Protectorates from disease and to the successful development of their veterinary, agricultural, and mineral resources.—*The Times.*

INSTITUTION NOTES.

Institution of Electrical Engineers. — New Subscription Rates —In our last issue we gave the existing rates of subscription of the Institution of Civil Engineers, and stated that new rates were under consideration. We are now enabled to give the schedule of the proposed new rates of subscriptions, as follows: —

	London.	United Kingdom (outside London).	Abroad.
Members ...	£7 0 0	£5 10 0	£4 10 0
Associate Members	4 10 0	4 0 0	3 10 0
Associates... ...	5 0 0	5 0 0	5 0 0
Students	2 0 0	2 0 0	2 0 0

It will be observed that Members and Associate Members not resident in London receive a concession on this score. We believe the increased rates are necessary to meet a probable deficit of over £10,000.

The very successful and largely-attended opening meeting of the 1921 session of the Institution took place on the 18th inst., at the Institution of Civil Engineers, Mr. Roger T. Smith, retiring president, in the chair. Mr. Smith announced the death of Prof. John Perry, and a vote of condolence and sympathy with his family and relatives was passed by all members standing in silence. At the conclusion of the formal business Mr. Smith presented the scholarship cheques and premiums awarded by the Council for papers read during the last session, and then invited the new president, Mr. Ll. B. Atkinson, to take the chair. Sir John Snell proposed, and Mr. J. S. Highfield seconded, in a few well-chosen words, a vote of thanks to the retiring president, which was carried with acclamation. Mr. Atkinson then delivered a *résumé* of his inaugural address, which is abstracted elsewhere in this issue. The meeting was brought to a close by Col. R. E. B. Crompton proposing, and Mr. W. A. Chamen seconding, a vote of thanks to the president for his address.

Sheffield and District Sub-Centre of the North Midland Centre.—The opening meeting of the 1920-21 session of this Sub-Centre will be held on Tuesday next, November 30th, at 7.30 p.m., at the Royal Victoria Hotel, Sheffield, when the business to be transacted will include the election of members of Committee; the chairman will speak, and the meeting will terminate with a smoking concert.

South Midland Centre.—A meeting was to be held at the Birmingham University, on November 24th. In the first part of the meeting the chairman was to make a statement regarding the proposed increase of subscription rates. Following this, an informal discussion was to be held on "Operation Methods and Difficulties of Electric Power Plants," opened by short papers by Messrs. Mackersie and Rogers.

Scottish Centre.—*Students' Section.*—The arrangements for the present session include the reading of papers on "Static Transformers," by Mr. R. Dickson; "Alternating Current compared with Direct Current for Distribution and Supply," by Mr. R. L. Birch; "Mercury Arc Rectifiers," by Mr. R. L. Morrison; and "Machinery Oparations in Automobile Construction," by Mr. R. J. Hird. Visits are to be made to the *Glasgow Evening News* printing offices, and to the Glasgow central telegraph and electrical departments.

North-Eastern Territorial Centre.—*Students' Section.*—A general meeting was held in Armstrong College, Newcastle-on-Tyne, on November 19th, when Mr. H. M. Rochester read his paper on "Electricity in Mines." The subject was dealt with in a very able manner, proving very interesting and instructive, as details were given of above and below ground working.

Wireless Section.—On Wednesday, November 24th, the session of the Section was opened by the delivery of an address by the Chairman, Dr. W. H. Eccles. Mr. Ll. B. Atkinson, the President of the Institution, took the Chair, and the Section was honoured by the presence of Dr. Alexander Graham Bell, the veteran inventor of the telephone. After his introduction by the President, Dr. Bell, who was received with acclamation, made a short speech, in which he said that the growth of the telephone had bewildered him and surpassed his most sanguine expectations. He was very glad to meet the members of the very advanced Wireless Section of the Institution. Dr. Bell instanced as an example of the progress of his invention, in conjunction with wireless waves, the recent experiments at Arlington (near Washington) when communication was established with the Eiffel Tower, Paris, and speech was heard at Honolulu.

Dr. Eccles's address sketched the history of the Section and of the recent developments in wireless. The formation of the Section was the outcome of a suggestion to form a body on the lines of the American Institute of Radio Engineers, when the Institution stepped in and offered its help, with the result that the Section was organised. The speaker then dealt with the immense progress following the introduction of the thermionic valve and other devices.

Scottish Centre.—Among the social arrangements made for the present session are a smoking concert at the Rankine Hall, Glasgow, on December 11th, and a *conversazione* and dance at the McLellan Galleries, Glasgow, on February 3rd, 1921.

The Physical and the Optical Societies.—A joint meeting of the above societies will be held at the Imperial College, South Kensington, S.W., to-day, at 7 p.m., when a discussion will take place on "The Making of Reflecting Surfaces." Section A will with "Technical Methods of Production," and Section B with 'Reflecting Powers of Surfaces," &c. A bibliography and *résumé* of the literature of the subject is in course of preparation by Mr. R. Kanthack.

Wireless Societies.—Southport Wireless Society.—Since its resuscitation about a year ago, the society reports that satisfactory progress has been made. Permission has now been received from the Postmaster-General to install wireless apparatus to be used within limited bounds. The society has also procured permanent headquarters, and the meetings this winter promise to be of a very interesting character.

Cardiff and South Wales Wireless Society.—At Cardiff on November 17th, Mr. W. A. Andrews, B.Sc., gave an interesting demonstration and lecture on the two-valve receiver and direction-finder manufactured by the British Thomson-Houston Co., Ltd., and Mr. E. A. Rudge, B.Sc., A.I.C., lectured on "The Electrical Properties of Some Metals." Mr. G. C. Hughes has resigned the post of secretary of the society, and Mr. W. G. J. Howe has been elected in his stead.

The Royal Society.—The Rumford Medal has been awarded to Lord Rayleigh, F.R.S., for researches into the properties of gases at high vacua; and the Hughes Medal to Prof. O. W. Richardson, F.R.S., for his work in experimental physics, and especially thermionics.

Cleveland Institution of Engineers.—Major H. G. Scott, in his presidential address, on November 15th, at Middlesbrough, said the electrical iron and steel furnace, for which so much had been claimed in the past few years, had settled down into its own useful, but subordinate, position in the steel industry. The promised 30-ton furnace had not yet materialised in this country. The fact was that the question of smelting by electrical energy was essentially one of cheap power, and even where power was cheap, a smaller unit, up to 10 tons, had been found to be most economical. Great developments had been taking place in the manufactured steel industry. Steam and manual labour were being rapidly superseded by electricity in rolling mills.

The speaker described recent developments in connection with the smelting plants of Messrs. Bolckow, Vaughan & Co., Ltd. The charging bay is served by two 50-ton overhead electric travelling cranes, specially designed for handling ladles containing iron from the blast furnaces. The casting bay is served by two 100-ton overhead travelling cranes. The mill is driven by a motor having a normal rating of 3,000 H.P. continuous and an overload capacity of 4,500 H.P. All work is done under cover, various bays being equipped with overhead electric travelling cranes, some of which are fitted with magnets.

Institute of Physics.—This Institute has now been incorporated, and has begun to carry out its work. The object of the Institute is to secure the recognition of the professional status of the physicist, and to co-ordinate the work of all the Societies interested in physical science or its applications. This co-ordination has already been secured by the participation of five of these Societies—namely, the Physical Society of London, the Optical Society, the Faraday Society, the Royal Microscopical Society, and the Röntgen Society. The Institute thus promises to become a powerful unit in connection with any wider scheme of federation of scientific Societies.

It is a tribute to the status already acquired by the newly-formed Institute that its diploma is now being required from applicants for Government and other important positions requiring a knowledge of physics, and, thanks in great part to the Institute, the physicist is now becoming recognised as a member of a specific profession.

The first list of members includes the names of ever 200 Fellows. Sir J. J. Thomson, O.M., the retiring President of the Royal Society, has accepted the invitation of the Board to become the first and, at present, the only, Honorary Fellow. The first President of the Institute is Sir Richard Glazebrook, K.C.B., F.R.S., who will preside at the first statutory meeting of the Institute early in the New Year.

Particulars with regard to the qualifications required for the different grades of membership can be obtained on application to the Secretary, 10, Essex Street, London, W.C. 2. Fellows elected before May 1st, 1921, will have the privilege of being styled Founder Fellows.

National Physical Laboratory.—The optics, thermometry, heat and radiology divisions of the Physics Department of the Laboratory will be open on Wednesday, December 8th, from 8 to 10.30 p.m., for the inspection of exhibits and demonstrations.

Chelmsford Engineering Society.—On November 18th, at the East Anglian Institute of Agriculture, Mr. G. Barlow delivered a lecture on "Practical Turbine Engineering." The paper dealt in detail with the various types of turbines and their history, the causes of their failures and breakdowns and the steps taken to overcome them. The secretary reported that the membership had increased to 116 since the opening of the session.

Edinburgh Electrical Society.—Mr. W. Hope-Fowler, M.D., F.R.C.S., lectured to the above society on November 19th, taking as his subject "Medical Electricity." The lecturer outlined the many applications of electricity to diagnosis and healing, and emphasised the increasing importance of electrical apparatus in hospital methods of treatment. He expressed the wish that British engineers would take a larger share in the design, development and standardisation of the relative appliances. The next meeting of the Society will be held in the Edinburgh Philosophical Institute on Friday, December 3rd, when Mr. James Walker will read a paper on "An Electrical Engineer's Walk Round a Factory."

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Mr. J. A. BROMLEY, A.M.I.E.E., assistant rolling stock engineer to the Leeds City Tramways, has been appointed tramway manager to the Borough of Keighley Tramway and Trolley Vehicles undertaking.

According to *The Times*, Mr. A. RICHARDSON, M.P. for Gravesend, who recently underwent a somewhat serious operation, is slowly improving, and his medical attendants regard the operation as successful.

The Nobel prize for physics for 1920 has been awarded to M. C. E. GUILLAUME, Director of the International Bureau of Weights and Measures at Breteuil.

Mr. W. T. DAVID, M.A., Cantab., D.Sc., Wales, has been appointed Professor of Engineering at the University College of South Wales and Monmouthshire at a salary of £1,000 a year. Mr. David, who is 34 years of age, has been Demonstrator of Engineering at Cambridge and Inspector of Technical Colleges, and during the war filled important positions at Woolwich and under the Ministry of Munitions and the Admiralty.

Mr. W. STEVENTON, provincial manager of the Commercial Cable Co., prior to leaving Liverpool to take up the position in London of assistant manager of the company in England, was presented with a solid silver tea service on a silver-mounted oak tray. Mr. J. W. Simpson will succeed Mr. Steventon in Liverpool.

Mr. C. W. CAMPION, district erection engineer of the Newcastle-on-Tyne branch of the Metropolitan-Vickers Electrical Co., Ltd., who is leaving the company's service to take up an appointment with the Indo-Burma Petroleum Oil Co., at Rangoon, was presented with a suit case and wristlet watch by the staff at a smoking concert held at the County Hotel on the 19th inst. Mr. H. Paterson, the district manager, was in the chair, and Mr. W. H. Dalgleish, on behalf of the staff, expressed their good wishes for Mr. Campion's welfare, whilst regretting the loss of his genial personality.

Councillor C. W. JACKSON and Councillor E. A. LITTLE have been appointed chairman and vice-chairman of the Hackney B.C. Electricity Committee.

Mr. G. E. MOORE has left the Cambridge and Paul Instrument Co., Ltd., and joined the Testing Department of the Newcastle-on-Tyne Electric Supply Co., Ltd.

Mr. A. F. HARRISON, secretary of the City of London Electric Light Co., has been elected treasurer of the Chartered Institute of Secretaries.

Mr. A. BROWN, of the order department of the Edison Swan Electric Co., Ltd., celebrated his golden wedding on the 16th inst. A few of the members of the staff, with whom he has been associated for 28 years, marked the occasion by presenting him with a clock suitably inscribed.

Obituary.—MR. C. READ.—The death has taken place of Mr. C. Read, electrical engineer, at the Granville Hotel, Ramsgate. He had charge of the hotel and its installation during the time it was used as a military hospital during the war.

MR. J. D. HICKMAN.—The death has taken place, suddenly, of Mr. John Dampier Hickman, electrical engineer, of St. Lawrence, Portsmouth Road, Long Ditton. Mr. Hickman, who was 61 years of age, was for some time electrical engineer to the Grand Duke Michael of Russia when he occupied Keele Hall, Staffs. At the time of his death he was negotiating for patents relative to a system of electric lighting and signalling for railways.

MR. P. F. HUDDLESTON.—We regret to announce the sudden death, which took place on November 1st, at Bedford, of Mr. Percy F. Huddleston, who was well known to a large number of our readers for many years as an electrical engineer, auctioneer and valuer, at Finsbury Pavement, London, E.C.

MR. R. FINNEGAN.—The death occurred at Northampton, on the 19th inst., of Mr. Robert Finnegan, railway and public works contractor. Mr. Finnegan was responsible for the laying of tramways at Great Crosby and Liverpool, and large works for the North Western Railway Co.

NEW COMPANIES REGISTERED.

J. B. Walsh & Co., Ltd. (171,396).—Private company. Registered November 13th. Capital, £10,000 in £1 shares. To take over the business of belting merchants, general mill furnishers, wholesale electrical factors, and dealers in lubricants, oils, and fertilisers carried on by J. W. Walsh and L. Bradbury at 34, Pall Mall, Manchester. The first directors are: J. B. Walsh, Brookside, Crofts Bank Road, Urmston, Lancs. (director Snowdon, Sons & Co. (Manchester), Ltd.); L. Bradbury, 10, Lancaster Street, Mossley, Lancs. (director Heginbotham, Gregson & Co., Ltd.); J. H. Jones, 63, Tweedale Street, Rochdale. Secretary: L. Bradbury. Registered office: 34, Pall Mall, Manchester.

T. J. Grainger & Co., Ltd. (171,501).—Private company. Registered November 18th. Capital, £5,000 in £1 shares. To take over the business of a dealer in electrical goods and colliery and engineering tools and appliances, carried on by T. J. Grainger, at 31, The Side, Newcastle-on-Tyne. The first directors are: T. J. Grainger (permanent), 31, The Side, Newcastle-on-Tyne; C. Meakin, 240, Farndale Road, Newcastle-on-Tyne. Registered office: 31, The Side, Newcastle-on-Tyne.

CITY NOTES.

Cape Electric Tramways, Ltd. The profit and loss account for the year ended June 30th, 1920, shows a profit of £77,280, and after providing for debenture interest and redemption of debentures, and including the amount brought forward, there is a net credit balance of £47,703. There has been put to reserve £12,000, 5 per cent. is to be paid on the ordinary shares, and £11,141 is to be carried forward. During the year the tramways carried 25,921,629 passengers, giving a return of £325,085, as against 27,993,276 passengers and £301,796 in 1918-19. The smaller number of passengers carried is due to the strikes which stopped the tramways for nearly a month, the increased receipts being due to raising the fares. The rolling stock in Cape Town has been increased by 12 new cars, which will materially assist operation and relieve the pressure on the rolling stock that has taken place in recent years. Under the Acts of Parliament which govern the concessions for the working of the tramways in Cape Town, the municipality had the power of expropriation of certain portions of the system during the year. This right, however, has not been exercised, and the time has now expired, but the municipality has approached the company with a view to purchasing the whole of the Cape Town system, but so far no satisfactory arrangement has materialised. The "B" debenture issue of £150,000 has now been entirely redeemed, and the charge against the profits for redemption ceases as from January 1st, 1920. Meeting in London, December 8th.

Submersible Motors, Ltd.—The report for the period October 1st, 1915, to December 31st, 1919, shows profit available for appropriation, after deduction of balance to debit of profit and loss at October 1st, 1915, £4,370, of £48,318. It is recommended to place £22,500 to taxation reserve, and pay dividends on preferred ordinary of 5 per cent. per annum (less tax) in respect of the year ended March, 1919, and at the rate of 10 per cent. per annum, less tax, in respect of nine months ended December 31st, 1919, carrying forward £6,088. Admiralty contracts as well as munitions levy and excess profits duty to cover several years, were settled after a considerable time had elapsed, and the directors consider it more suitable to present the accounts as a whole for several years instead of for each year separately. It is proposed to close accounts in future on December 31st.

Brisbane Electric Tramways Investment Co., Ltd.—The Queensland Government having failed to exercise its right to purchase the Brisbane tramways on September 20th, 1920, the Brisbane Electric Tramways Investment Co. suggests that holders of its 4½ per cent. first debenture stock should consent to postponement of payment for three years while the question is being settled with the Queensland Government as to the purchase of the undertaking. It is proposed that the interest shall be raised from 4½ per cent. to 8 per cent. for the period, and that 2 per cent. extra shall be paid if the debentures are redeemed within three years. A meeting is called for December 8th to consider the matter.

Stock Exchange Notices.—The Committee has specially allowed dealings in the following under Temporary Regulation 4 (3):—

Aldershot Gas, Water & District Lighting Co.—£50,000 7 per cent. mortgage bonds, redeemable January 1st, 1931, £10 paid. (Registered.) After issue of allotment letters.

The Committee has ordered the following to be officially quoted:—

Pernambuco Tramways & Power Co., Ltd.—51,426 ordinary shares of £1 each, fully paid (Nos. 950,001 to 1,000,000, 1,170,969 to 1,172,368, and 1,219,003 to 1,919,028).

A Dutch Company.—The Algemene Nederlandsche Electriciteits Maatschappij (late Groeneveld, Ruempol & Co.), of Amsterdam, which has a paid share capital of 1,500,000 fl., is making a loan issue for 600,000 fl. at 7 per cent. The company was formed in 1917, and a new factory will shortly be brought into operation to meet the growing demand for manufactures.

Westinghouse Electric Manufacturing Co.—Stockholders of the Westinghouse Electric Manufacturing Co. have voted an increase in the capital stock of the company from the present 75,000,000 dollars to 125,000,000 dollars. The directors have also been authorised to increase the indebtedness of the company by 30,000,000 dollars.—*Reuter's Trade Service* (Pittsburg, U.S.A.).

Allgemeine Elektrizitaets Gesellschaft.—At the general meeting of shareholders called for December 16th the directors of the company will propose a dividend of 14 per cent., compared with 10 per cent. last year. The net profits amount to 45,707,352 marks, as against 27,031,447. It is proposed to allocate 12 million marks to institutions for the benefit of the staff and workpeople.—*Reuter's Trade Service* (Berlin).

Rees Roturbo Manufacturing Co., Ltd.—Dividend of 5 per cent., less tax, on preference shares for 1912, 1913, and 1914.

Power Gas Corporation, Ltd.—Dividend at the rate of 8 per cent., less tax, for the year ended September.

New Issues.—*Hadfields, Ltd.*, are inviting applications for an issue of £1,000,000 7½ per cent. 10-year first mortgage debenture stock at 98, repayable at 102 on February 1st, 1931. The proceeds of the present issue will be used in defraying the cost of adapting the works to post-war conditions, including the completion of foundries, forges, and large and small rolling mills; in additional working capital, and in extending the operations of the company.

Cape Copper Co., Ltd.—Issue of 1,200 registered convertible 8 per cent. debentures of £100 each at par; the debentures will be repayable at par on November 1st, 1930, or at the company's option in whole or in part at £110 per cent., together with any accrued interest, by one calendar month's notice at any time after November 1st, 1923.

Electric Construction Co., Ltd.—Interim dividends at the rate of 7 per cent. per annum on the preference shares, and at the rate of 6 per cent. per annum on the ordinary shares, both less tax.

Calcutta Electric Supply Corporation, Ltd.—Units sold to consumers during four weeks ended August 27th, 1920, were 3,381,784, the corresponding four weeks of last year 2,779,110.

Yates & Thom, Ltd.—Dividend of 10 per cent., less tax, on the ordinary shares, £10,000 to reserve, carrying forward £10,680.

Petters, Ltd.—Interim dividend of 5 per cent. per annum, free of tax, on ordinary for half-year.

STOCKS AND SHARES.

TUESDAY EVENING.

THE fog which, early this week, made itself so unpleasantly insistent around the City and some of the suburbs, found fit reflection in Stock Exchange markets. Indeed, financial conditions of all kinds may be described as obscure and depressing. Commercial companies will not draw much consolation (although they may change their previous standpoint) from Mr. McKenna's explanation that banking facilities are restricted owing to the demands of the Government for money. Mr. McKenna inferred that the banks would be willing to lend to commercial customers were it not for the fact that the Government wants the bulk of the loanable capital. Customers may perhaps discover herein a new source of grievance against the Government's mania for wasting money. Nor does the course of the rates suggest that local authorities have yet awakened to the desirability of giving an innings to economy.

The Brisbane Electric Tramways Investment affair, to which reference was made here last week, is arousing keen discussion and no small amount of attention. The directors say that in the present circumstances they cannot raise the money necessary to pay off the £450,000 4½ per cent. debenture stock which falls due for redemption on January 1st next. Some of the stockholders talk about pushing the matter to extremes and insisting upon having their money five weeks hence. Others argue that it is no use attempting to extract blood from a stone, and that acceptance of the Board's proposal to raise the interest to 8 per cent. and postpone redemption for another three years is the more practical policy. The meeting of stockholders will take place, as mentioned previously, on December 8th next. Meanwhile, the price of the ordinary shares is quoted at about 4, while the 5 per cent. cumulative preference are 3½, changing hands at this price a few days ago. The debenture stock, which was up to 97½ a week ago, has gone back to 94.

British Columbia Electric stocks continue to attract a little interest, and the deferred is a good market at 58½. Rio Trams are 88, after being 92, and San Paulo Firsts 88. Kaministiquia fell 3 to 106½. There is not much change this week in other dollar stocks, although the numerous commercial failures which are occurring in the United States have the effect of diminishing the value of the dollar as compared with that of the £ sterling. This would help our commerce in the ordinary course of events, but as things are at present, it is of no great value. Mexican issues are lower, part of the substantial rise of last week having been lost. For instance, the 5 per cent. bonds of the Mexico Tramways have receded 2½ to 43¼, and the Sixes are 1½ down at 33½. Rumours are rife from time to time as to revolutionary movements having broken out again in Mexico, and, although nobody pays much heed to them, they do have their effect in markets so dull as those of the present moment. Mexican Light and Power Firsts at 57½ are ½ down, but Pachuca bonds, Monterey Fives, and others of this kind are unchanged. Brazil Tractions at 42 are 3 lower, and other Brazilians are inclined to give way. Para Electric 6 per cent. preference at 12s. are sixpence down.

Home Railway stocks make no better showing than foreign rails. The exception is furnished by Central London preferred ordinary, which has risen to 46 on a small demand in a market in which there is no stock offering. This is a condition which would probably apply to many things, not only amongst Home Railways, but also in other departments of the Stock Exchange, and were there to be any demand, the scarcity would stand revealed, causing prices to mount sharply. With nobody wishing to buy, however, the disposition is to let prices sag where they move at all. Underground Incomes have dropped 3 points to 65½, and the 1s. shares to 6s. 3d., while the £10 shares weakened ½ to 42s. 6d. Districts fell to 17½.

The only change amongst electric lighting shares is a fall of ½ in Westminsters, reducing the price to 5 again, and thus raising the return on the money to the round 10 per cent., a yield which is afforded also by Bromptons at 6 and London Electric preference at 3. Charing Cross ordinary pay 10½ per cent. on the money, County ordinary about the same, and Metropolitans nearly 10½ per cent., taking the last declared dividends as the basis of calculation. Amongst manufacturing shares, Edisons are flat at 15s. English Electrics are dull at 16s. 6d., the preference being 15s. and the debenture stock 83½. British Aluminiums at 18s. are a florin lower, and India-Rubber shares at 1 3/16 show 1/16 decline. Siemens, on the other hand, have recovered a little after their drop of last week on the new issue. Babcock & Wilcox remain at 2½, and the engineering group as a whole is coloured by the same tendency as that shown elsewhere. Rubber shares keep flat, owing to the outlook in the trade itself and the price of rubber. The new issue of Explosives Trades Notes maintain ½ premium with noticeable steadiness. The price of the issue was 96½, and scrip is changing hands fairly readily about 97, buyers having to pay rather more. William Beardmore 8 per cent. seven-year Notes, offered at 97½, have dropped to 5½ discount on the underwriters getting 58 per cent. of the stock.

Not even the Cable group can withstand the prevailing state of depression. Globes and Eastern Extensions are both ½ lower. Anglo-American deferred dwindled to 16½. Marconis again shed 1/16, and Canadians at 8s. 6d. are a trifle easier. Business in this section is quiet, as it is elsewhere. And as, perhaps, it may remain in the Stock Exchange for the remainder of this year.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price Nov. 23, 1920.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	6	12	6	—	£16 0 0
Charing Cross Ordinary	4	7	8½	—	10 15 6
do. do. 4½ Pref.	4½	4½	27	—	8 8 8
Chelsea	3	4	8½	—	6 8 0
City of London	8	10	11	—	8 17 10
do. do. 6 per cent. Pref.	6	6	17/6	—	6 17 1
County of London	7	8	7½	—	10 13 4
do. do. 6 per cent. Pref.	6	6	8½	—	7 7 8
Kensington Ordinary	6	7	8½	—	9 0 6
London Electric	Nil	2½	3	—	8 19 6
do. do. 6 per cent. Pref.	6	6	8	—	10 0 0
Metropolitan	6	6	8½	—	10 8 8
do. 4½ per cent. Pref.	4½	4½	9½	—	8 0 0
St. James' and Pall Mall	10	12	6½	—	9 4 8
South London	5	6	8½	—	9 13 6
South Metropolitan Pref.	7	7	16/8	—	8 12 6
Westminster Ordinary	8	10	6	— ½	10 0 0
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	77½ xd	—	7 14 10
do. Def.	33/6	1½	16½	— ½	9 1 10
Chile Telephone	6	6	5½		*5 9 1
Cuba Sub. Ord.	7	7	7	—	*10 0 0
Eastern Extension	8	10	15	— ½	*6 13 8
Eastern Tel. Ord.	8	10	15½	— ½	*6 11 4
Globe Tel. and T. Ord.	8	10	15½	— ½	*6 12 4
do. do. Pref.	6	6	8½	—	8 17 3
Great Northern Tel.	22	22	20½	—	10 14 6
Indo-European	18	18	90	—	8 6 8
Marconi	26	26	2⅞	— 1/16	8 16 0
Oriental Telephone Ord.	10	13	2½	—	*4 18 4
United R. Plate Tel.	6	8	6½	—	*6 10 8
West India and Panama	1/8	Nil	¼	—	Nil
Western Telegraph	8	10	15½	+	*6 12 4
HOME RAILS.					
Central London Ord. Assented	4	4	43½	—	9 4 6
Metropolitan	1	1½	20½	—	6 2 0
do. District	Nil	Nil	17½	— ½	Nil
Underground Electric Ordinary	Nil	Nil	2½	— ½	Nil
do. do. "A"	Nil	Nil	6 6	— 9d.	Nil
do. do. Income	5	4	65½	— 3	—
FOREIGN TRAMS, &c.					
Anglo-Arg. Trams First Pref.	Nil	5½	8	—	9 8 4
do. do. 2nd Pref.	Nil	Nil	2½	— ½	Nil
do. do. 5 Deb.	5	5	59½	— 3	8 8 0
Brazil Tractions	Nil	Nil	42	— 3	Nil
British Columbia Elec. Ry. Pfds.	5	5	59	—	8 9 6
do. do. Preferrred	3½	5	58½	—	*5 19 8
do. do. Deferred	Nil	3	59½	—	*5 17 6
do. do. Deb.	4½	4½	57½	—	7 7 10
Mexico Trams 5 per cent. Bonds	Nil	Nil	44½	— 2½	Nil
do. 6 per cent. Bonds	Nil	Nil	53½	— 1½	Nil
Mexican Light Common	Nil	Nil	16	—	Nil
do. Pref.	Nil	Nil	28	—	Nil
do. 1st Bonds	Nil	Nil	57½	— ½	Nil
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	32	—	*8 6 4
British Aluminium Ord.	10	10	18/-	— 2/-	11 10 2
British Insulated Ord.	12½	15	13	—	9 4 8
Callenders	25	15	1xd	—	10 0 0
do. 5½ Pref.	5½	5½	18/9	—	6 18 8
Castner-Kellner	20	17	8	—	5 12 4
Crompton Ord.	10	10	17/6	—	11 8 6
Edison-Swan	10	10	15/-	— 1/-	13 6 8
do. do. 5 per cent. Deb.	5	5	74½	—	6 14 3
Electric Construction	10	10	4	—	11 6 6
Gen. Elec. Prof.	5½	5½	18/6	—	7 9 5
do. Ord.	15	10	1½	—	*7 12 8
Henley	20	15	1½	—	9 4 8
do. 4½ Pref.	4½	4½	5½	—	7 4 0
India-Rubber	10	10	1 3/16	— 1/16	*8 8 0
Met.-Vickers Pref.	—	6	2	—	8 0 0
Siemens Ord.	15	10	1⅞	— ⅛	*8 4 0
Telegraph Con.	20	20	21	— ½	*5 14 3

* Dividends paid free of Income Tax.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

Inaugural Address of MR. LLEWELYN B. ATKINSON, President. *(Abstract.)*

We have had, particularly of later years, presidential addresses of such importance and merit that in a way they become the keynote or *motif* of the whole presidential work, and if we look back to the earlier presidential addresses, we see how this function has grown in importance.

But the real work of the President does not lie in his Address. For the year of his office he is, as it were, the chairman and managing director of, and the co-ordinating element in, this great Institution; and the increasing weight of his duties demands consideration.

In our institution the meetings have increased in number with the formation of various sections, some of which at least, in addition to the ordinary meetings, the President attends; there are 13 Centres and Sub-Centres which it is his duty if possible to visit during his year of office; there are Committees and Joint Committees on the greatest variety of subjects of importance to the profession and industry, and those who have of recent years had the honour of being President, have found that it is becoming for the year of office nearly a whole-time job. Unless these tendencies can be modified, it will result that few members of the Institution will feel able to undertake properly the office of President, because they will be unable or unwilling to devote the time and administrative effort necessary to the office.

The year 1921 will see the Institution of Electrical Engineers attain its "jubilee"; the Society of Telegraph Engineers was formed on May 17th, 1871, when 66 names were submitted and duly elected as members; of those 66 I believe that only two are now living, viz., General E. D. Malcolm, of Poltalloch, R.E., and Sir Herbert Jekyll, K.C.M.G. The first general meeting of the Society was held on February 28th, 1872, when the first President, Dr. William Siemens, delivered an address dealing principally with the objects of the Society, viz., the reading of papers and their discussion by members, and generally an exchange of knowledge and opinions on electrical subjects. The Society, which in the year 1888 became the Institution of Electrical Engineers, retained that point of view for the first 35 years of its existence; by a process of evolution or growth, the Institution has, however, reached a position where it no longer stands only for a science, but stands for, and claims to represent, a science and an industry based upon that science. The Institution of Electrical Engineers is the first of the great Institutions to be forced by the circumstances of its industry into such a position. The Institution of Civil Engineers is definitely a body to protect the interests of engineers as engineers, recognising and certifying to their engineering training and knowledge. The Institution of Mechanical Engineers may be said to stand for the same view, but the Institution of Electrical Engineers, whilst certifying by its membership to a standard of engineering skill, goes further, and endeavours by its activities to promote the interests of all its members, in directions which do not necessarily depend on their particular status or skill. This function of its activities has, to a considerable extent, been brought about by the fact that electrical engineering is largely concerned with public services, and hence the intrusion into its affairs of Governmental and municipal regulations in a degree quite unapproached in civil or mechanical engineering.

The increasing and broadening sympathy existing between the Institution of Electrical Engineers and all classes in the industry may be traced to the time when definitely or implicity the great difference between it and the older Institutions was recognised and the work of the Institution adapted to the needs of the industry.

The great extension of the activities of the Institution through its 12 Territorial Centres and Sub-Centres, whilst it has raised the Institution to the position of the most active engineering force in the country, has created its own special problems, and notably that of finance. In the past the leading engineering Institutions, including the Institution of Electrical Engineers, have maintained in London a home and have held regular meetings, generally at fortnightly intervals, and published the "Proceedings" thereof, and at that point they have been content. In our own case last session the number of meetings of all Centres and Sections at which papers were read or discussions took place was 105.

These meetings, however, involve considerable expense. The expenses of meetings are twofold; for meetings in our own building, only extra lighting, cleaning, and some refreshments are added, but for provincial meetings there is, in addition, rent of meeting places. Above all, however, there is involved the extra printing.

The cost of printing and posting the *Journal* in 1914 was £2,000 per annum, and this has risen until in 1920 it has reached £6,000 per annum. There is little doubt in my mind that some form of drastic editorship of the discussions and "Proceedings" will have to be put in force if the present number of papers is to be published. The single fact that members of the Institution have to grasp is this: that this Institution is giving more to its membership than any British Engineering Institution has ever attempted; and comparisons of the cost of the working of our own Institution and the necessary subscription thereto with those of other Institutions have no common basis.

It was in 1873, the second year of the life of the Society of Telegraph Engineers, that the first edition of Clerk Maxwell's "Treatise on Electricity" appeared. That treatise was the starting point of modern electrical theory.

To-day the work thus started with Maxwell has been largely completed. Our knowledge of the fundamental basis of electricity, viz., the electron, has reached a high degree of certainty and precision of measurement, leaving us with the unsolved problem which electrical science is doubtless called upon to solve, viz., the nature of the atom.

Tied up with this problem will lie the complete solution of the problem of temporary and permanent magnetism. We had last session a very able and suggestive contribution by Mr. Evershed to the latter discussion, and I think the suggestions put forward by him were a great stride forward. The discovery of radium and radioactivity in 1898, and the proofs that chemical atoms are not, as till then supposed, eternal, but are subject to change, radioactive atoms themselves breaking up into other chemical atoms and electrons, was no less than an absolute revolution in thought.

We have come to realise that we cannot regard the electron as something by itself, having a fixed inertia mass. The electron cannot move without setting up movements in the ether involving the storage of energy therein, and the amount of those movements depends on the acceleration and also on the velocity of the electron. The inertia mass of the electron therefore is in part or wholly an expression of a rate of storing energy in the ether. Experimental investigation seems to show that the whole mass, or apparent inertia mass, of an electron may be thus accounted for, and it is clear that at least some part, if not the whole, of the inertia mass of all matter arises from the energy effect of the ether disturbances which take place when matter is accelerated, and these disturbances being transmitted with a finite velocity the inertia mass of all matter in whole or part depends on the velocity with which it is moving.

It is quite clear, therefore, that we as engineers have to accept considerable changes in the views on which the scientific training of most of us has been based.

Of the strictly technical problems of the future, the first is the more complete realisation of the value of our fuel. The change of the last seven years in the value of fuel, not only measured in terms of currency, but also in terms of human effort, has turned upside-down all previous considerations, and the immediate problem of electrical generation to-day appears to lie in the direction of more complete utilisation of fuel by selective distillation with recovery of useful products, and in the use of gas and coke in the boiler furnaces, or by complete conversion of the coke into gas for use in gas engines.

The gas turbine has made some progress, generally on the lines of multiple explosions discharging gases into a turbine wheel, but, speaking without detailed knowledge of the latest developments in this direction, I believe that the future gas turbine will work on a cycle of combustion at constant pressure with adiabatic expansion through nozzles giving the gas the necessary velocity for a turbine wheel, the constant pressure for combustion being obtained by pumping the air and gas into the turbine through regenerators heated by the waste heat. I am aware that this class of cycle has had consideration and been rejected largely on account of the losses incurred in the compression part of the cycle, but the inherent advantages of such a cycle for large units are so great that I cannot help thinking that sooner or later the difficulties of the compression part of the cycle will be overcome.

The heat engine and dynamo as the elements for transforming the energy of fuel into electric currents have reached a stage of efficiency where there is little further to be hoped along the present lines, and in the direction of output for a given weight of material we have reached the point where, notwithstanding the small loss which is transformed into heat, the output is really limited only by the necessity of surfaces to dispose of this heat. Last session we had a very suggestive paper by Mr. Shepherd which, with the discussion pivoting on it, indicated that the next step will be the complete water cooling of the machinery, again enhancing the possible output.

There still remains the possibility of some completely new process, which will eliminate the heat engine and dynamo and substitute some other method of producing the electron stream that we call the electric current, by a process which does not involve the efficiency limits imposed by the second law of thermodynamics, as, for example, the possibility of electrically unlocking the stores of energy in the atom.

In this connection I cannot overlook the possibilities suggested by what is called the photo-electric effect. When light of certain wave-lengths falls on a metal the metal becomes positively charged, electrons being liberated. As far as we know, the energy which the liberated electrons possess is greater than that supplied by the light wave, if the energy of the wave is uniformly distributed. The "quantum" theory

assumes that the energy of the wave is concentrated in finite portions, which are sufficient to account for the result, but this seems to me a very forced conclusion, and one much less likely to be true than an explanation which is based on the idea that there are great stores of energy in the atoms, and that by the application of a small resonant effort we can release this energy at the expense of the internal energy of the atom. Photo-electric cells capable of generating small currents have been produced, but the whole subject is as yet waiting further research.

The discussions and uncertainties surrounding the future programme of electrical generation and distribution have had and are having a very serious and detrimental psychological effect on the engineering and directional staffs of the supply industry.

The position of these staffs, especially in the smaller municipal undertakings, has never been very happy. Men of considerable engineering ability, but perhaps not so well equipped as in the case of larger undertakings with commercial or diplomatic talents, have had to contend with an environment in which local and labour politics formed a dominating feature. While in many cases the difficulty was minimised by the help of a sympathetic committee, or chairman of committee, the result has been in a great many cases to produce a final condition of semi-apathy.

This has been greatly aggravated in the last year or two, when, in the belief that all the smaller stations were to be swallowed up, even the higher staffs of company-owned undertakings as well as the committees of municipal concerns have lost their interest, which in the latter case was often a personal or local enthusiasm, and have simply carried on with a minimum of exertion. Whilst it must be admitted that the appointment of the Electricity Commission and all it involves has been loyally accepted, largely due to the confidence which the personality of the Commissioners inspired, yet even this has led to an attitude of mind whereby the Commissioners have come to be regarded as the *Deus ex machina* who shall solve all problems and resolve all troubles.

Engineers of small undertakings are generally the commercial managers as well, but their work and pride are on the engineering side, the generating station and distribution system. The realisation that sooner or later the generation will cease and the distribution only remain, and that salesmanship rather than engineering skill will be the feature looked for, is naturally not very agreeable to these men. This class of men is in fact going through what the craftsman goes through when machinery replaces his skill, and they feel very much as he does when he is assured that eventually machinery causes more employment, not less. We must face the fact that one reason why the larger generating stations will be more economical than the smaller ones, is the decrease in the total amount of skilled superintendence that will be necessary, and that this class of occupation will diminish. The compensation must be found in the increasing use of electric current, and the engineer's function must be diverted to all that this involves in finding new openings, designing equipment for new operations, and in stimulating consumption and the distribution therefor.

The results of the trials and experiments on a great many types of cables have led to the result that to-day it may be said that the vulcanised rubber-insulated cable holds the field for internal work, that for underground mains of low and medium pressures vulcanised bitumen cable or paper-insulated lead-covered cables are standard practice, whilst for high pressures paper-insulated lead-covered cables are used exclusively. The early paper lead-covered cables did not aim higher than 11,000 volts, and to-day the British Engineering Standard tables do not go further, but cables of 20,000 and 30,000 volts are extensively used, cables of 50,000 or 60,000 volts can be obtained from responsible manufacturers, and were there a real necessity cables of 100,000 volts would be forthcoming commercially, either of ordinary types perhaps with graded dielectric, or with pressure-distributing metallic layers forming part of the dielectric enclosure.

Constant research work and experiments have been devoted not only to the materials employed, but to the method of manufacture, and above all to the improvement of methods of installation of jointing and protection, a large part of the trouble with cables being with these accessories.

The pioneer work of Price on the North-East Coast of ring-main high-pressure feeders with discriminating protective devices, with various detail modification, gives, with a minimum of mains, an almost absolute immunity from breakdown for the individual consumer. This system is now attracting considerable attention abroad, where so far no such security of supply has been realised. In most cases special forms of cable are being used, but efforts are being made to adapt the principle to ordinary cable systems.

The future progress seems to lie in the direction of the improvement of the material in two directions. The researches of Evershed on characteristics of insulation and of Addenbroke on dielectrics, which have been published through our Institution, have shown that the limits of dielectric strength and the losses of power in dielectrics under alternating pressure are due to the presence of moisture. The organic cellular structure of paper leads to its being very hygroscopic, and the greatest difficulty is found in drying out all the moisture and maintaining the dielectric moisture free at all stages of manufacture. There are organic threads which are practically non-hygroscopic, but they cannot be made into papers or woven for the very reason that their surfaces are so smooth, and so it would appear as if either papers must be chemically altered or that a new method of applying felted fibrous materials and then securing in place must be devised to use such fibres.

In addition to such lines of research in any case the constant improvement of quality of paper in the sense of elimination of weak spots is taking place. The dielectric strength of paper as used for cables is, say, 500 volts per mil, but the dielectric is only operated in cables at, say, 50 volts per mil, a wide margin being necessary to cover the inequalities of the material and the irregular and unexpected rises of pressure to which they are subjected. The great fall in the price of rubber, from 11s. 6d. per lb. in 1911 to 1s. 6d. per lb. in 1920, if permanent, may have a bearing on future types of extra-high-pressure cables.

In 1914 the Postmaster-General appointed a committee to consider the question of high-speed telegraphy. The definite conclusion reached was that for this country the multiplex system was superior to the automatic, and that a special apparatus named in the report included all the features considered desirable, viz., a free keyboard perforator, five-unit code, and printing direct in page form. Such an apparatus working duplex with quadruple sending and receiving sets at each end would dispatch from 40 to 50 telegrams per hour per operator, that is 160 to 200 messages each way per hour. One such apparatus dealt with two-thirds of the whole Manchester-London traffic, and very few circuits could keep one apparatus occupied. Hence we may certainly say that, even for crowded traffic, invention is really ahead of requirements. The use of apparatus like high-speed telegraphic apparatus is under Post Office conditions complicated by staff questions, and the practice in the Civil Service of selecting the higher grades by seniority and not by technical or temperamental merit, thus making it difficult to ensure that the overlooking of a staff is done by one specially skilled in working and adjusting a number of circuits.

Probably the most needed apparatus to-day is a cheap and simple transmitter worked from a typewriter keyboard, and a cheap and simple printing receiver to replace the hand-operated sounder instruments of smaller offices, for the reason that there is an ample supply of people able to use typewriters, and the printing receiver obviates clerks skilled in reading Morse code. For the smaller offices, the telephone has replaced the single needle instrument which was used.

The latest form of repeater is the thermionic valve tube, so arranged that a small incoming disturbance causes an amplified local current to work an ordinary electromagnetic relay. The effect of this with similar valve relays on the receiving instrument is to enable much smaller currents to be used, so that it is contemplated to use conductors of hard-drawn copper weighing only 20 lb. per mile for all telegraphic circuits, instead of conductors weighing as at present, say, 200 lb. per mile, with such repeaters, say, 100 miles apart.

In 1871 the mirror galvanometer and siphon recorder were the reading instruments used, and with them a speed on the Atlantic cable of 15 words or, say, 75 letters per minute was obtained. Heavier conductors, improved methods of working, the use of inductance shunts, and the use of very sensitive relays such as the Heurtly and the Brown, have brought the speed up to 300 letters per minute under duplex conditions of working, and permit of Morse printing instruments being used, whilst the ubiquitous thermionic amplifying valve is producing a further increase due to the possibility of operating it with a smaller current than any other relay, and so enabling a smaller fraction of the incoming and increasing current at the receiving end to be utilised; in other words, each signal can be shorter.

We often see comparisons made, to our own detriment, as to the number of telephones per head of the population in this and other countries, but probably if we had a comparison of the messages per telephone, or even the total number of messages per head of the population, a different story would be told. It is clear that, in a sparsely populated district, communication by telephone attains an importance which it does not reach where all necessities and markets are near the door. But, at least in densely populated areas, an economic factor arises which differentiates the telephone from nearly every other business.

In most businesses the cost of an individual service becomes less as the number of services increases. In the case of a telephone exchange the operating cost of each connection increases as the total number of connections increases, for the simple reason that each individual can make and does make more calls. It is for this reason that comparisons of the annual cost of a telephone are quite fallacious unless the number of calls is referred to, and why any system of flat-rate charging is inequitable.

The problem for telephonists therefore becomes the technical one of keeping all main and junction lines working fully, this being a question of the proper distribution of centres and sub-centres, together with the proper system of charging so that every user pays for what his service costs. In this connection the system whereby the Post Office records the charges and renders an account at intervals, which there is no means of checking or disputing, is most unsatisfactory, and sooner or later some method of rapidly agreeing a call as registerable, so that it can be questioned there and then, must be put in force. The automatic system lends itself to a development

of such a method of record, one on which practically no dispute could arise, except as to inaccurate mechanism.

The future of wireless signalling is hardly to be estimated. The immediate future will probably see all other methods of generating oscillations give way to the thermionic tube method. In detail rather than principle does this differ from the arc method where the discharge of electrons from the hot carbon fulfils the same purpose as the discharge of electrons from the hot wire of the tube, but the advantage in steadiness of temperature and resistance lies with the tube, enabling the wave-length to be held more constant. Already demonstrations with tubes up to 20 KW. have been given.

(To be concluded.)

North-Western Centre.

At Manchester, the chairman of the above Centre, Mr. Julius Frith, M.I.E.E., delivered an address at the first meeting of the 1920-21 session, of which an abstract follows:—

The inquiry: What are the methods in use for supplying power to industries, and what are the available sources of energy we can tap for the end in view? would, perhaps, put us a bit out and make us think. After a little of this unwonted exercise, we might summarise the situation as follows:—

The radiation which the earth receives from the sun, although not itself heat, is absorbed and converted to heat on striking against a more or less opaque body. Sufficient of this energy can be concentrated on, say, a boiler, and so made to work a steam engine and produce power. This device is feeble and not suitable for use in our centres of industry.

On the second application of the sun's activity, *i.e.*, using the sun as a circulating pump to lift water from the sea to the mountain tops, Nature and civil engineering helping, we can extract and put to useful work some 90 per cent. of the potential energy of the water, that is in places which are blessed with a climate; in the British Isles, where there is only weather, water power is not so reliable.

As to the moon being a source of energy, the problem is not so simple as it looks, and the energy which is really tapped in harnessing the tides is due to the difference between the time of revolution of the earth and that of the moon round the earth; making use of the tides would tend towards keeping the moon always opposite one fixed point of the earth's surface.

Winds are at best uncertain, though they have been extensively used for grinding corn, pumping water, and driving small electric generators.

The electro-chemical effect is the most promising of those investigated so far: the conductor which suffers disintegration only does so in proportion to the electricity set in motion, there are no moving parts, and the efficiency is very high. The destroyed conductor has in the past been made of some very costly material, and there is no ready market for the chemical combination produced; but these are minor points which can no doubt be remedied when we have time to give to them.

Molecular activity is at the moment a little new and puzzling, but it is very promising. In energy given out per pound of material, it exceeds anything else by several millions per cent. It is, certainly, a little difficult to stop and start, and seems a trifle like using up the bricks of which the universe is built, but we shall no doubt be able to report further to a future meeting.

For the moment we make heat by combustion, and are still at a loss for a means of converting this to mechanical energy. We need some connecting link between the fire and the generator shaft. Now we find ourselves in the painful position of making a practice of rejecting the connecting medium when it is only about one-fifth expanded, and the best that the engine can possibly do is to use, say, 19 per cent. of the total energy for the production of mechanical energy. These large amounts of energy received from the fire and rejected by the engine are usually not only wasted, but become a source of annoyance to our neighbours. We are accustomed to refer with pride to "the age of steam," but steam, like Jacob, has usurped the place of the first-born not by historic right, nor by any particular aptitude for the rôle, but mainly through the influence of its godfathers Watt and Stephenson. Several other fluids have been proposed, but engineers have turned up their noses at all such and, truth to tell, their noses would be the chief sufferers!

There are, however, some other promising avenues of attack on the problem. One is to make the condenser itself a source of heat for a second thermal-cycle engine, and this idea has not received the attention it deserves from practical engineers, though it has been carried some little way on the theoretical and experimental side and has shown some promise. Another line to follow would be not to condense the exhaust at all, but to pump it straight back into the boiler or heater, there to receive another supply of energy; but this is, apparently, contrary to the laws of thermo-dynamics as we at present understand them. If we could only find some way of putting the exhaust steam back into the boiler as it is released from the engine, instead of making it return to water to be again re-evaporated by our precious fuel just the other side of the boiler plates, the possible efficiency of a steam engine might be almost indefinitely increased.

Combustion of most fuels with the oxygen of the air will produce temperatures in the region of 2,000 deg. F., thus giving us a possible efficiency of $(2{,}000-100)\div(460+2{,}000)$, or 77 per cent. Our present practice is to employ our 2,000 deg. F. in raising steam and superheating it to, say, 600 deg. F., giving a possible efficiency of $(600-100)\div(460+600)$, or 47 per cent. This shows up our wrong-headed way of stating boiler efficiency by expressing it as heat delivered over heat received, ignoring the temperature and, therefore, the *availability* of the heat. One might almost as well calculate the efficiency of a water turbine as water emitted over water supplied.

The gas turbine offers a possibility of using the high initial temperatures, but it would probably exhaust at a temperature comparable with that of an ordinary boiler fire. Further use of the hot exhaust gases could then be made for raising steam.

In a recent Government report it was estimated that on the average 5 lb. of coal is burnt for each horse-power-hour produced in industrial power plant.

	Therms.	*Per cent.*
Received:—		
5 lb. of coal at, say, 13,000 therms per lb.	65,000	100
Paid out:—		
Proportion used for banking boilers at nights and week-ends	6,000	9.3
Lost in ashes	1,000	1.5
Sent up the stack as hot gases—100 lb. at 500 deg. F. excess temperature	12,000	18.5
as steam in the flue gases	2,000	3.0
as carbon imperfectly burnt to CO. ...	1,000	1.5
Radiation from boiler, engine and steam pipes	4,000	6
Mechanical friction of engine	250	0.4
Sent to cooling towers in circulating water (7 lb. of steam per lb. of coal, 1,000 therms per lb. of steam)	35,000	54
Used in auxiliaries	1,200	1.8
As one brake H.P.-hour	2,550	4
	65,000	100

Four per cent.! The efforts of the reformer may well quail before the stupendous loss carried away by the condensing water and made hideous in the cooling towers, and by other losses which can be reduced. Embodying such refinements as have been at present achieved in the best steam practice, and working at a good load factor with any large turbine plant, one brake H.P.-hour may be produced from one pound of coal.

Let us now turn to the internal combustion engine and gas producer. Average practice in moderately small non-recovery plant yields about 1 H.P.-hour for each pound of coal.

The largest of the losses is that carried away in the exhaust gases. A good deal of this can, however, be used for raising steam in a special form of fire-tube boiler, but here again we are limited in the amount of heat we can extract from the gases by the undesirability of condensing the steam they contain; this is another case for the cheap feed-water heater. However, as it is, nearly two-thirds of the heat in the exhaust can be used for raising steam, which may amount to 2 lb. of steam per pound of coal put into the producers.

The next serious loss is that in the water used for cooling the gas-engine cylinders. This is more difficult to negotiate, as low-temperature heat is rather a drug on the market. Probably, unless there is a demand for hot water for some other purpose, the best plan is to combine gas and steam plant, using both the gas-engine cylinders and the exhaust to raise steam, which is used in another cylinder driving on to a common crank-shaft.

Another proposal that goes much more to the root of the matter, is known as the "Still" engine,* which employs a common cylinder, one side of the piston being acted on by the gas and the other by the steam generated by the heat in the exhaust. I believe the "Still" engine will "get a move on" presently.

The recovery of by-products largely turns on whether the recovery producer can or cannot be made self-supporting in the matter of the steam it uses. The auxiliary boiler on the exhaust of the gas engine can provide the necessary steam for this purpose, but if the producers can make their own steam and more, it becomes frequently a question between the relative values of coal and by-products whether it does not pay to gasify the coal used for steam power plant; this will probably, however, only be done by people whose main business is the supply of power, as others will not often want to combine manufacturing chemistry and salesmanship of fertilisers with their other activities.

It only waits, however, for the perfecting of the gas turbine to make the gasifying of coal and the recovery of by-products a foregone conclusion. At the back of all this is the immense possibility of gasifying what would otherwise be waste fuel.

There is another possible way of utilising the heat of combustion and converting it into electrical energy, namely, by means of the thermo-pile. It was pointed out above that there is an unnecessary loss of temperature between the fire and the water in a boiler, say, 2,000 deg. F. to 400 deg. F. This temperature difference could be used in a battery of thermo-piles having their hot junctions in the fire and their

* Elec. Rev., May 30th, 1919, p. 643, and June 20th, 1919, p. 720.

cool junctions in the water. The heat which would otherwise be wasted is then used in raising steam, and the heat that disappears in the Peltier effect is converted into electrical energy at 100 per cent. efficiency. For every 1 per cent. of th total heat generated which is thus converted, the yield per pound of coal burnt is increased 4 per cent. in the best, and 25 per cent. in the average case.

When all our national resources are used as they ought to be used, ample power will result as a by-product, when all fuel charges will be struck out of the bill for power. It will then remain for engineers to reduce capital charges, which can be done slowly by reducing the cost of plant, but much more quickly by increasing the load factor and diminishing the transmission losses of big power stations. Manchester has given a lead in this direction by the cultivation of large power consumers situated near to the station and willing to accommodate their demands to the exigencies of the other loads.

There is a possibility that the use of steam might be justified if the latent heat in it could be extracted and used for some useful purpose, such as process work in the factory or a commercial supply of hot water.* It may be perfectly true: (1) that what the industrial household is most in need of is a supply of hot water for washing the person, the clothes, and the culinary apparatus; and (2) that the power station without much interfering with its function as a power station could supply hot water. Taking for granted items (1) and (2), and an industrial community of, say, 10,000 inhabitants grouped into 1,670 households of six members each, three of whom are working, their houses, arranged on garden-city lines, eight or nine to the acre, and allowing for wide roads and ample open spaces, would occupy about three-quarters of a square mile. The demands for electrical energy per household will be about 6,400 units per annum for those employed in the factories (1 H.P. per individual), 500 units for lighting and cooking in their homes, and 100 units for carrying the household about in tramcars and for public lighting; total, 7,000 units per annum per household. As there are 1,670 households the town would require a power station turning out about 12 million units per annum, which at 25 per cent. load factor would have a maximum load of a little over 5,000 KW.

Suppose the station to work with a vacuum of about 20 in., it would take about 20 lb. of steam per unit, which could, on condensing, yield 20 gallons of hot water at about 160 deg. F., so that we have an average of 400 gallons of hot water per household per day. Allowing 50 gallons per day for baths and washing, 350 gallons are left for warming the house. If we allow the water to cool from 160 deg. to 100 deg. F., about 200,000 therms are liberated per 24 hours, which is sufficient to keep a five-room house comfortably warm. (This corresponds in heating effect to about 2½ KW. for 24 hours.)

In a town of this size there are about 15 miles of roads. To carry the hot water from the central station four 5-in. mains will suffice; from these would radiate 2-in. mains; and from these a ¾-in. service would supply each house. Flow and return pipes would be provided, the flow pipes being lightly lagged. The loss from these pipes would amount to less than 15 per cent. of the heat delivered to the houses if the lagging of the flow pipes allowed half of one therm to escape per 1 sq. ft. per hour per 1 deg. F., which would not be considered a very good steam-pipe covering.

The total cost of the pipes, including lagging, excavating, laying and filling in, would be about £45,000. The extra plant required at the central station might add another £5,000; 6 per cent. interest and 2½ per cent. depreciation (21 years' life) = £4,250 per annum = 1s. per week per house, which surely would gladly be paid for this service.

Discussion.

Alderman W. Walker, who opened the discussion which followed the delivery of the address, complimented the chairman on his departure from the customary practice of treating the chairman's address as not being a subject for debate. With regard to Mr. Frith's proposals for supplying hot water for an industrial community of 10,000 inhabitants, the first thought that occurred to the speaker was, what a nice view they would have when they rose in the morning and saw the central power station firing up to prepare hot water. Also there must be a railway right through the site to get to the central station, and a lavish outlay on roads for carting fuel and removing ashes. Then he feared a large proportion of the houses would become vacant because people objected to the amenities usually associated with a power station; they had no power stations which were not looked upon as nuisances, although they had tried to take them away from the homes of the people they served. The City of Manchester was the most lavish user of water in the kingdom, largely for industrial purposes, but the consumption of water, cold and hot together, did not approach the figures that Mr. Frith had estimated to be the consumption of hot water by his community; therefore, there would not be the market he had anticipated. With regard to the number of units which would be used per household for lighting and heating, he did not know of any undertaking that could show an average consumption approaching that figure for houses of the class which he had described. It was useless to proceed by finding out how many therms they would have at their disposal and then fit them into the amount which the people ought to use; they must find out what they were likely to use, what were the practical possibilities of the scheme before committing themselves. He thought that a very great deal more could be done by utilising the waste heat of power stations in providing heat for the community. In Manchester they had been asked again and again to sell a great deal more than they did; a number of large buildings in Peter Street, the C.P.A., "The Refuge," and the warehouses, were heated by waste steam from the city stations, but when they studied the problem of carrying the pipes a little further afield they came up against the enormous cost of getting them through the streets. After all they could not justify attempting to utilise a waste product if the expenditure became greater than the loss incurred by treating it as waste. It would need very careful consideration, especially in the case of an established city, with congested roadways, existing lines of pipes, and the other factors which entered into the question. Mr. Frith emphasised the possibility of the products of combustion (other than electricity) becoming of such value as to enable the electricity to be looked upon as a by-product, but for the time being there did not appear to be any reasonable or practical means of arriving at such a result. Mr. Frith did not mention the practice of bleeding the turbine for the purpose of heating the condensate that was becoming an established practice, and was usually justified by the results obtained.

Mr. J. A. Robertson expressed the view that if one could lay out a colony in an area remote from industrial districts and set up houses in the nice order shown in Mr. Frith's diagram, putting a camouflaged power station in the centre (with perhaps a golden dome upon it, and conveying the smoke away underground), and take the condensing water from a pond round the station, he could understand that under such circumstances gas engines might show a very big overall efficiency. If one could deliver the water from the jackets of the gas engines, heated with the exhaust gases, and at the same time get a high thermal efficiency of the engines producing electricity, he believed one might show something approaching the ideal of 50 per cent.; a thermal efficiency of the gas engine alone of about 24 per cent. could be obtained. Mr. Frith gave as the cost of the pipes, including the lagging, a capital amount of £50,000, upon which he reckoned 6 per cent. interest and 2½ per cent. depreciation (21 years' life), making £4,250 per annum. Dividing by the number of houses that worked out, as he said, at one shilling per week per house, but he allowed nothing for the cost of the heat which was going to work his engines with 20 in. vacuum. Without his hot-water system he would run his engines at 26 in., or in the case of a turbine probably at 28 in. vacuum. The difference between the 20 in. and the 26 in., or the 28 in., meant something like 25 per cent. on the fuel bill, and with a power station giving about 12 million units per annum, taking 3 lb. of coal per unit, that meant something like 3,000 additional tons of coal required for the heating system. At the present price of coal that meant £5,000 or £6,000 per annum, which made the figure 2s. 6d. per week per house. The Electricity Commissioners had delimited many areas in this country, and all the leading electrical engineers in the country had prepared, or were preparing, schemes of electricity supply, but he did not think any one of them would include gas engines or gas producers. The controversy really all turned on the value of the by-products; if one could obtain a good price and market for them, something might be said for it, but he did not agree with Mr. Frith's suggestion that, even apart from by-product recovery, gaseous fuel should be used for the purpose of raising steam instead of retaining what he described as "the barbarous practice of burning solid fuel on the bars."

Mr. Dundas pointed out that there were many unknown factors; the data now available gave them something to work upon, but there were many limiting factors. The area of supply was restricted by the high capital outlay required, the loss on transmission was a disadvantage, and it was very difficult to get that nice coincidence of the heating load and the electrical load. The market was also a fluctuating one, in summer time there would be very little demand for heat. A supply of hot water from a central heating plant could not be given for less than 1s. 6d. per week at the minimum. Mr. Dundas criticised the consumption figures given by Mr. Frith, and suggested that the station would necessarily have to run in parallel with other stations. The increase in the quantity of coal required for generation he calculated to be about 1,000 tons per annum running at such a low vacuum. He did not think one could get water at a temperature of 160 deg. with a 20 in. vacuum. With the interest on the capital outlay he made the total £6,000, or approximately £3 12s. per house, or 1s. 4½d. per house per week. There would not be much profit out of 1s. 6d. per week.

Mr. S. J. Watson said that the figure of 5 lb. as the average amount of coal burned for each H.P.-hour produced in industrial power plant was taken from a return which was some years old. During the last six or seven years great improvements had been effected in the overall thermal efficiency of most of the power stations in this country. The highest thermal efficiency one could obtain in a power station

* Mr. Pearce has had examples of this at work in Manchester for years. See also Elec. Rev., July 5th, 1919, p. 20.

was of the nature of 20 per cent., and ten years ago the average was somewhere about 5 or 6 per cent. To-day there was a large number of power stations operating regularly with an efficiency of from 11 to 13 or 14 per cent., and there was at least one example in this country of a power station operating at about 17½ per cent. They were approaching the highest point that Mr. Frith thought possible. His own opinion was that in the future they would see developments of the internal combustion type of prime mover, and there was no doubt that if a suitable metal could be devised which would stand the intense stresses, the internal-combustion turbine would become a practical proposition. They had reasonable hopes that in the near future such a gas turbine would be evolved. Mr. Frith's figures showed that the efficiency of the prime mover itself would be about 19¼ per cent., but the exhaust gases carried away some 38 per cent. of the total therms contained in the coal. It was in the utilisation of a portion, at any rate, of that 38 per cent. that improvement would be made. The development of the internal-combustion turbine seemed not unlikely to entirely revolutionise present methods of heat generation. He was surprised that in speaking of the various sources of the supply of energy Mr. Frith did not refer to the atmosphere. Some few years ago they heard a great deal about the supply which might be obtained by means of kites.

Mr. Digby, apart from the question of the thermal efficiency of the domestic grate, thought that against the cost of the system of a communal hot-water supply, Mr. Frith might have put forward the cost of the coal required in the average household in his city; that would do a very great deal to commend the system. They recognised that in a dense industrial town the problem was at present too difficult, but as the garden city idea developed, and they tried to move the masses of population into healthier and more hygienic surroundings the communal system would appeal to them both as engineers and as citizens.

Mr. J. S. Peck explained that there was one case besides Manchester where exhaust steam had been used for heating purposes. That was in a small suburb of Pittsburg; it was a residential district, and there was a generating station which supplied lighting for the community. He remembered seeing them tearing up the streets and laying several miles of pipes which were very heavily lagged. As far as he knew the system was a success, but soon afterwards the central station was purchased by one of the large supply companies in Pittsburg, and the old system was shut down. Probably the pipes were there yet, and he expected the original owners would sell them cheaply.

Mr. J. Frith, in reply, pointed out that the conclusions he arrived at were not based on the circularity of Manchester, and the central station might even have a golden dome on it with advantage. If it was true that the industrial inhabitants of Manchester did not use 50 gallons of hot water per day per household he thought it was quite time that they did so. The 7,000 units included the factories, and he provided tramcars for carrying the people to and from work. His domestic demand was 500 units per annum, which was what a house of that particular size required for electric lighting and cooking. As there were several new industrial garden city communities being established, his plea was: "Don't lose sight of the possibility of supplying hot water to those new communities that are being started." As regarded a congested area, one could supply it with fewer pipes and with less loss in the distribution. With regard to the point about the power station working with a 20 instead of 26 in. vacuum, the coal required for heating that water was saved on the 1,670 houses, in each of which one would have one or two fires working at a very low thermal efficiency. Could one imagine 1,670 dwellings using as little as 1,000 tons of coal per annum? He did not propose using any cooling towers; their purpose was served by the hot water tanks in the houses. The water was circulated round, and instead of losing its heat on one cooling tower, it was losing its heat in heating the houses. Mr. Robertson gave quite as much as he took away in suggesting that a gas set would be an even better thing for a hot-water scheme than the steam engine, but it was put forward as a last stronghold for the advocates of steam. If they could only use the latent heat which was now wasted it might give steam a little longer life. If Mr. Robertson thought the speaker was advocating the universal use of non-recovery gas plant for steam-raising purposes he was mistaken. If one could work the self steam-raising recovery producer with its own steam it became frequently a question between the relative value of the coal and by-products whether it did not pay to gasify coal for steam plant instead of burning it on the bars. If it could make its own steam it might be the right thing to gasify fuel. Mr. Dundas was wrong in saying that one could not get water at 160 deg. from a 20 in. vacuum. Whether it was 1s. 4½d. or 1s. 6d. that the household would have to pay per week, either figure was ridiculously cheap; it could be made 2s. 6d. The point about the different times of peak loads of electricity and hot water was a good one, but one must remember the enormous thermal storage of hot water, and one could use that thermal storage—the enormous number of B.Th.U.'s that were circulating around in the hot water—to overcome that difference in the time of the maximum loads. The gas turbine might be a solution of a great many troubles by being able to take a high T_1, but in one respect it had an immeasurable inferiority to steam. The power of being able to condense steam, and with a temperature of about 100 deg., which was about the lowest cooling temperature which they could use, to get an absolute pressure of 1 lb. per sq. in. was a very remarkable property of steam, and one which gave it a very great advantage. With the gas turbine the trouble would be that one would not have pressure and temperature in the right proportion. That was the trouble with gas turbines, even if one found a material with which to make blading which would stand the erosion of burning gases. Although a boiler might have a thermal efficiency of 100 per cent. if it let heat drop in temperature without making it do work in the process that was a thermo dynamic sin, and one which was lost sight of when one got into the habit of expressing efficiencies as thermal efficiencies. If they worked out the thousands of tons of coal per annum which heating with hot water would save, the amount would exceed very much the extra coal which the station would burn due to the low vacuum. Whether it was winter or summer, cold or hot weather, one always had fires to get hot water, and that meant an enormous waste of fuel. The laying of pipes was not an insuperable expense even at present prices. It was questioned whether 2,000 therms in 24 hours would heat a house. In the days of rationing he would have been very glad of that amount to heat his house. To give an industrial house with six inhabitants heat equal to a 2½-kw. radiator going all the time would be enormously better than any conditions which they had now.

Western Centre.

At Bristol, at the first meeting of the 1920-21 session, Mr. A. J. Newman, chairman of the above Centre, delivered an address, of which an abstract follows:—

Happily, each year finds the Institution, as a whole, growing in membership, utility, and prestige; and, largely as a result of this, the greater importance of engineering to the general community, is becoming more publicly appreciated. It appears practically certain that if it does not fall to the lot of the Institution of Electrical Engineers, ultimately there will be other bodies recognised as authoritative in defining status, and in forming an engineers' register. In view of new factors, it certainly seems justifiable that managerial engineers should formulate plans for protecting their own distinctive interests.

Unfortunately, the average engineer is left with merely a minimum of time for the study of economic and social questions, but he cannot disregard modern developments, which may affect appreciably his personal liberty and position, and if the engineer can bring his creative, well-balanced faculties and influence to assist in national and local government affairs, it will be all to the good. All general prosperity depends upon the prosperity of sound public industrial undertakings, from which our workmen are right to expect their fair share of profits.

Industrial and financial conditions are, unfortunately, so turbulent and precarious to-day that it seems incumbent upon all officials and thinkers to reason patiently with the workmen whenever opportunity for discussion is afforded. In the past we have neglected this important aspect of verbal influence and mental co-operation, and partly because of such failure, we are now reaping the consequences.

Passing from the important factor of man power in industry to that of motive power, one turns, almost instinctively, to the problem of an ample and reliable supply of cheap electrical power. When all want more money and shorter working hours, we must solve the problem by greater provision of efficient machinery of production, of which motive power is certainly the most important.

In the Electricity (Supply) Act, 1919, the difference between a Joint Electricity Authority and a District Board is that the Joint Electricity Authority must be representative of existing authorised electrical undertakers (and presumably all of them) within the district, though it is left optional whether it has also to be representative of county councils, local authorities who may not be authorised undertakers, consumers of electricity, and other interests. In the case of a District Board, however, representation has to be given to all the interests above enumerated. With this exception, there is little difference between the Joint Electricity Authority and the District Board. The Act provides, in Section 18, that the Ministry in question "may construct works or acquire land." Although the term "land" is legally understood to include both the land itself and anything that stands upon it, it has been held that the section in question does not allow for the acquisition of works which are already constructed.

Under the Act it is not intended that any Joint Authority shall make any profits; the results of economies are all to enure to consumers. Such being the case, it at once appears that companies forming part of a Joint Authority would only profit indirectly through added facilities and an expansion of their business. Presumably, however, if such companies give financial assistance or guarantees, they might reasonably anticipate receiving some favour, as compared with other consumers who may not give such support. Similar remarks may also be applied to other authorised undertakers, local authorities, and county councils.

Seeing that the acquisition of works is not compulsory, what will happen in the case of any particular undertaking not voluntarily falling into line with the proposals? Since no new generating stations may be constructed, and no existing station extended, without the authority of the Electricity Commissioners, it is reasonable to suppose that no such works will be carried out if a supply can be given from the central authority at a figure at least as good as that at which the particular undertaking in question could itself furnish the supply. Further, one has always to bear in mind that, in all probability, those who support the scheme will be justified in asking for rather more favourable terms of supply than others. It may, therefore, be reasonably anticipated that in most districts Joint Authorities will be formed, although there may be difficulty in amicably balancing up all the interests of the various undertakers in each area.

The rate of progress which might have been anticipated a year or two ago will, however, probably be less rapid. Delay may result in view of the present state of the money market, as capital charges per kilowatt of plant installed are now three times those which obtained before the war. Obviously the new plant to be installed in a capital station would have to be compared with the cost of the existing cheaper plant belonging to present undertakers. As money is so dear, and there are now so many sound investments giving a good return, one has seriously to consider if investors would be readily found to loan money to Joint Authorities on the security of works owned or taken over by them alone. I am of opinion that little in this respect could be accomplished, and that it is absolutely imperative that financial clauses, such as were contained in the original Bill, should be passed in a new Act. The security of the rates of county councils and local authorities may then be given, as well as the financial backing of companies within the area. Whilst it is necessary to have the backing of the local rates, &c., it may be pointed out that, in giving such backing, the local authority does not really incur any risk, because the Joint Authorities must be self-supporting, and there is no reason at all why they should not prove to be so. This assumes, of course, that their constitution is so drawn up that, those who have voting power, also carry financial responsibility proportionate thereto, such financial responsibility being borne either directly or through them by the authorities whom they represent, whether local authorities or otherwise.

Owing to the present state of the financial market, it may oe necessary, or at any rate wise, that Joint Authorities be formed covering districts although there is no immediate prospect of giving a supply from a central source in such districts. It is most important that there should be unity of ideas and purpose throughout the district at the outset. Efforts for standardisation should also be made immediately.

It is gratifying to learn that our organisations, both from the manufacturing and technical aspects, are able to equip satisfactorily the biggest stations as yet proposed, and that experts are available for their successful operation. In the actual lay-out and construction of a super-station, the main initial problems to be solved may be stated as follows: (*a*) an adequate supply of water; and (*b*) the maintenance of a continuous supply of fuel in case of external disturbance. In connection with (*b*), the problems of coal and ash-handling plant have also to be faced, and in the case of large power stations, the capital outlay involved by such auxiliaries with the necessary railway sidings represent no inconsiderable portion of the total expenditure.

In order to minimise these difficulties a floating power-station has been proposed. Such a station constructed entirely with its complete equipment, say, on a huge raft, would seem to present certain definite advantages. If oil fuel were employed, the tankers conveying the fuel from the oil fields could be moored alongside the station, and the oil pumped direct into the storage tanks. Thus railway transport charges would be entirely eliminated, as well as the risk of interruption to supply due to breakdown in railway facilities, strikes, &c. In addition, an adequate supply of cold water for condensing purposes would always be available, and the head on the circulating pumps would be a constant minimum. Such an arrangement would also appear to have the advantage that, if the station were composed of separate units, any of them might be transported without dismantling to another site should necessity arise. The raft might be of cellular construction, thus lending itself readily to commonly-accepted power-station design in that certain of the cells could be utilised as condenser basement, oil and water storage tanks, &c. The construction of the raft itself would be expensive, but against this must be offset the cost of a suitable site and foundations for a power house erected on land. Moreover, no coal sidings, cooling towers, or culverts, and only a minimum of coal and ash-handling gear, or water piping, would be required; and, in addition, the mobile cold water supply would ensure maximum efficiency. As an alternative, such a station could be built by the sea shore; the relative merits of the two alternatives would, of course, depend on the local conditions which prevail.

The enormous increase in cost, of both labour and material, and the enhanced cost of money, is forcing manufacturers to consider every means for reducing the dimensions and price of their apparatus. Apart from minor refinements in design, the possibility of such reduction in cost lies along one of three main lines: higher speeds, higher temperatures, and better cooling facilities. The tendency in this country is now to use mica insulation on large machinery to a much greater extent, thus taking advantage of higher temperatures. Few people realise the enormous quantity of dust which is carried, either on or through the windings, of a modern alternator may require, say, 27,500 cu. ft. of air per minute the air surrounding a generating station may have as much as 0.0006 lb. of dust per 1,000 cu. ft., and that a 5,000-KW. alternator may require, say, 27,500 cu. ft. of air per minute for cooling purposes. Even if the machine is only in operation for 50 per cent. of its time, as much as two tons of dust per annum, under such conditions, have to be dealt with by the filtering arrangements employed.

Large supply authorities have been keen to realise the advisability of employing a competent meter engineer conversant with three-phase power measurement. Satisfactory metering is not only a safeguard on the revenue side, but assures a satisfied customer, and the adoption of 2 or 3 meters in series, for large consumers, has proved a wise investment when queries arise about accuracy of accounts. Whilst the maintenance of a good power factor is generally stipulated in supply agreements, means of getting a reliable check on power factor has, so far not been largely adopted. I think, however, the employment of a sine meter (in conjunction with a watt-hour meter) has been found to be as satisfactory an arrangement as any yet proposed for ascertaining the average power factor over a given period. I would also suggest that a good deal of contention with consumers would be avoided if a maximum-demand system of charging was adopted based on the K.V.A. instead of on KW. demand.

Certain progress has also been made in the development of the high frequency synchronised relay. This relay has so far been introduced chiefly for the control of street lighting, thus avoiding pilot cables. It appears to me, however, that application of the system might be extended to the control of those customers who are supplied on off-peak or two-rate tariffs, thus dispensing with the usual controlling clock or time switch, and its attendant disadvantages. The main recent development on rotary converters, seems to be the gradual adoption of higher speeds. Refinements include improved methods for seasoning commutators at higher speeds and temperatures than are likely to be reached in practice. Special care taken in this part of manufacture is, it seems, amply repaid by the greater elimination of commutator faults. Much work has been done in improving mercury vapour rectifiers for large outputs. In order to obtain parallel operation between different rectifiers, or between a rectifier and a rotary converter, it is necessary to adopt a number of somewhat complicated devices, and it appears scarcely feasible to operate a rectifier in parallel with a compound-wound rotary or generator. The difficulty of parallel operation is doubtless one of the reasons why the rectifier, in the past, has not met with a better reception.

Considerable progress has been made in the development of transformers of high voltage and large output. For large sizes forced oil cooling is now usually adopted, the oil being circulated through a cooler and back through the transformer tank. For one super-station scheme six 3-phase transformers, each for 20,000 K.V.A., at 33,000 to 6,000 volts, are proposed. If such 3-phase units are adopted, instead of single-phase, they will be the largest so far built in this country. The biggest sizes so far actually constructed appear to be those at Glasgow Corporation's Dalmarnock station, viz., 7,800 K.V.A., single-phase, oil-insulated, forced-cooled, 20,000 to 6,000 volts, 25 periods, three of which form a 3-phase group of 23,400 K.V.A., which is relatively 45,000 K.V.A. at 50 periods. Five such groups are in operation or being built. The largest 3-phase, self-cooled transformers built, so far, in this country as one unit are 4,000 K.V.A., 6,000 to 12,000 volts, 50 periods. High-voltage types for 50,000 volts, 2,000 K.V.A., are at present being constructed for export to Spain. Present necessity for economy, in capital outlay, is being met, to a large extent, by the use of weather-proof transformers. One British firm is at present building 12,000-K.V.A., weather-proof groups for 66,000 volts, and 5,000-K.V.A. groups for 33,000 volts, three single-phase units forming one 3-phase group. Another tendency is towards the use of dry type air-blast transformers for voltages up to 11,000, due partially to the present shortage and price of transformer oil.

An effort is now being made on all large new schemes to standardise high-pressure voltages. A generating voltage of 6,600 volts, and transmission voltages of 11,000 and 33,000 volts, are being advocated. These pressures seem to represent the highest voltage for which alternators can be wound consistently with safety, and the most economical for the transmission distances at present being considered. Higher transmission pressures will, doubtless, be proposed when general linking-up is contemplated. I am inclined to suggest that laying cables direct in the ground will become more popular than the use of troughing and bitumen filling. I am inclined to favour overhead transmission lines constructed on the split-conductor system, as it seems a pity to expend large amounts of capital on catenary suspended pilot cables necessary for other systems of protection. In comparing the two alternatives, we must not lose sight of the difficulty and expense of maintaining overhead construction, which expense has to-day an appreciable capital value. Each transmission scheme will have to be considered on its merits, as such factors as contour of ground, saving of route length by avoid-

ing detours, wayleaves, clearings, &c., may turn the scale in favour of either system.

Standardisation of apparatus appears to be making continued progress. The various makes of motors now offered are exceedingly numerous, even important general dimensions, such as length or width between feet, and height of centres, are invariably so divergent that only minimum progress appears, as yet, apparent in standardising such details, which are often vital when a user wishes to replace urgently any machine by that of another maker. One hopes that the tendency towards wider scientific management will not embrace the application of so-called laws worked out abroad, and suitable only for abroad. In this country it can safely aim at the fullest endeavour to win the co-operation of every worker by fair dealing, encouraging each employé to appreciate his or her co-operative functions, and the necessity for eliminating waste in all directions—waiting for materials, defective tools, unnecessary lifting and handling of material, bad transport, &c. Scientific management is essential to modern conditions and its wider, or sounder, adoption will be doubtless only a matter of time. Incidentally, it has been stated, by an old-time private manufacturer, to be nothing new, but just the general managerial application of his own methods of patience, goodwill, fairness, and common sense.

THE INDUSTRIAL COURT.

The Electrical Trades Union and Colchester Corporation.

We have received from Mr. W. J. Webb, Secretary of the E.T.U. and of the Home Counties (No. 9 area) Joint Industrial Council, a copy of the proceedings and decisions of the Industrial Court regarding an application from the Electrical Trades Union that the agreed schedule of consolidated rates as fixed by the District Council No. 9 (Home Counties) of the Joint Industrial Council for the Electricity Supply Industry should be paid to the workpeople concerned employed by the Electricity Department of the Corporation of Colchester.

Representatives of the parties were heard in London on October 22nd, 1920. (See Elec. Rev., p. 638.)

The contention of the Union was that the Corporation was represented directly or indirectly on the National Joint Industrial Council and on District Council No. 9, and was consequently bound by the decisions of the Council.

The Corporation representatives intimated that they had refused to take any part in the proceedings of the Joint Industrial Council, and that they did not consider themselves in any way bound by any decision of the Council.

The grades of employés concerned, together with the rates at present paid and the rates claimed, are set out below:—

Grade	Present rate per hour including war advances.	Consolidated rate claimed per hr.
Fitter-Turner ...	1s. 6½d.	2s. 0d.
Mains Foreman ...	1s. 6d.	£5 per week.
Meter Repairer ...	1s. 7d.	2s. 0d.
Repairer & Fixer	1s. 4½d.	1s. 8d.
Fixer & Reader ...	0s. 11d.	1s. 7½d.
Fixer & Reader ...	0s. 10½d.	1s. 7½d.
Fitter's Mate ...	1s. 3d.	1s. 7½d.
Jointer's Mate ...	1s. 2½d.	1s. 7½d.
Labourer	1s. 2½d.	1s. 6½d.
Driver	1s. 3½d.	1s. 9½d.
Driver	1s. 3d.	1s. 8½d.
Stoker	1s. 3½d.	1s. 8½d.
Coal Trimmer ...	1s. 2½d.	1s. 7½d.
Coal Weigher ...	1s. 0½d.	1s. 7½d.
Filter Attendant...	1s. 3d.	not specified
Carpenter ...	1s. 5½d.	not specified

The Corporation met the Union representatives on October 18th, and endeavoured to arrange a compromise on the claims put forward, but this was not accepted.

The two main reasons put forward by the Corporation for not acceding to the claims were its inability from the financial point view, and that the rates claimed were higher than necessary in the circumstances, and higher than those paid in the town and district for fairly comparable work. It was stated that for the last five years the working of the undertaking had shown a total deficit of £7,656. The price per unit in 1916 was 1¼d. for power and 4¼d. for lighting, and in 1920, 2½d. for power and 9d. for lighting. It was submitted that any additional charge in respect of wages would result in further serious financial embarrassment.

It was shown that the rates claimed were being paid generally throughout the area to the grades of workers concerned in the electricity supply industry.

It appeared to the Court that it was not necessary for it in the circumstances to deal with the question whether or not the Corporation was directly or indirectly represented on the Joint Industrial Council or was under any obligation to observe the decisions reached by that body. Whatever might be the conclusions of the Court on those matters, it was sufficient for the purpose of the present decision that according to the evidence the rates claimed were being paid generally throughout the area by electricity supply undertakings. The Court had had careful regard to the facts submitted with respect to the financial position of the present undertaking, and it took those facts into account in determining the date as from which the rates claimed should operate. It did not appear to the Court, however, that the conditions in Colchester were so exceptional that the rates of wages paid should be lower than those generally applicable to and paid by similar undertakings in the same area. The decision of the Court after careful consideration of all the facts and evidence submitted was that the rates set out in the schedule referred to in the terms of reference should be paid to the respective grades of workpeople concerned, except filter attendants and carpenters, and that the advance in rate due in respect of each worker should take effect as follows: half the amount as from May 1st, 1920, and the remaining half as from January 1st, 1921. The schedule did not specify the rates to be paid to filter attendants and carpenters, and the schedule was therefore inapplicable to these grades. The Court, however, recommended that the case of these men should be considered by the Corporation, having regard to the Court's decision with respect to the other grades concerned.

THE PHYSICS AND CHEMISTRY OF COLLOIDS AND SOME INDUSTRIAL APPLICATIONS.

Faraday Society and Physical Society Discussion.

In our last issue we summarised the major portion of this discussion. The remainder dealt with Precipitation in Disperse Systems—Cataphoresis and Electro-Endosmose.

These two sections of the subject, being somewhat allied, were taken together after a brief introduction, going back to first principles, by Prof. Alfred W. Porter, F.R.S. As already stated, a colloidal particle carries an electric charge, and consequently if a colloidal solution is placed in an electric field, motion must take place; either of the solid if in the form of a mobile suspension—that is, cataphoresis—or of the liquid if the solid is in the form of a fixed porous membrane—that is, electro-endosmose. The origin of the charge has usually been ascribed either to the interchange of electrons across the surface of contact of liquid and solid, with the consequent formation to a "double-layer," or else to the absorption of ions by the colloidal particle. This theory was elaborated and clarified in an important paper contributed by Mr. J. N. Mukheijee, who started with the observed fact that for most suspensoids the charge is of the same sign as that which the ion substance has in common with the peptising or stabilising electrolyte that must be present in the disperse medium. The fixation of a common ion is due to the same causes that bring about the growth of a crystal in its solution, where the attached molecule conforms to the structure of the crystal. Ions are similarly fixed by "chemical" absorption, after which "electrical" absorption comes into play and attracts ions of opposite sign. This is the origin of the double layer. Mr. Mukheijee subjects his theory to rigid numerical tests, and he adduces strong support by showing that whereas the presence of univalent ions in solution seldom brings about a reversal of the original charge in an electrolyte having multivalent ions of opposite sign, a reversal is more frequent. Furthermore, the order of absorbability of cations by a negatively charged surface deduced from his theory is the same order as the precipitating power of those ions for a number of widely differing suspensoids.

Prof. McBain made a most interesting contribution to this portion of the subject in bringing forward the experimental discovery that the conductivity of a potassium chloride solution was 9 per cent. greater when measured in a fused silica capillary tube 0.24 mm. in diameter than when in bulk. This was ascribed to the absorption of chlorine ions by the silica walls, leaving more potassium ions available for carrying current. The layer of chlorine absorbed was found to be one molecule in thickness.

Dr. W. R. Ormandy's paper dealt with the practical applications of cataphoresis and endosmose. One of the most important of these is the electrical purification of clays due to the work of Count Schwerin, and it is of particular interest on account of the very direct applications of colloid physics and chemistry which it illustrates. The broad principle of the process is the subjecting of a clay suspension to the action of an electric current. The suspenion being a colloidal one, the clay particles are charged negatively, and hence they are carried by the current to the anode of the cell or osmose machine in which the treatment takes place. But in order to increase the reactivity of the clay suspension, certain colloidal substances are added which are selectively absorbed by the clay, and these in turn absorb to themselves charged ions from the electrolyte. Thus the whole of the clay is converted into the said condition, and is separated out by the action of the current while the impurities are sedimented out. But the interest of the process does not cease here. Through the film of purified clay deposited on the anode, electro-endosmose comes into play, causing the water in and around the clay particles to be driven out and thus pure, almost dry clay is extracted from the machine. In treating a very pure specimen

of a well-washed English china clay, as much as 6,833 kilos of dry clay have been deposited with an expenditure of 11.8 kilowatt-hours at a pressure of 50 volts.

Dr. Ormandy proceeded to draw attention to other industrial applications of cataphoresis and electro-endosmose. We can refer briefly but to a few of these. The *drying of peat* in an electro-osmose filter can be successfully carried out, but the conditions prevailing in countries where peat is found are not favourable at present for the production of cheap electricity from water power. *Colloidal silica* has been made from silicate of soda solutions. The silicic acid solutions have been largely used on the Continent for therapeutical purposes and an inert highly electro-negative finely divided colloidal gel obtained therefrom has been proved to have extraordinary properties as an absorbent for use on wounds. In Germany two factories are employing an electric *tanning* process, in which the energy consumption has recently been reduced to 6 or 7 kilowatt-hours per square metre of hide. In this, as in the other electro-osmose processes, progress has chiefly resulted from the discovery of suitable membranes for enclosing anode and cathode. Other processes referred to were the *concentration of iron ores* from clay deposits, where the addition of an electrolyte brings about selective absorption of ions on the ore particles and hence susceptibility to electrical forces; the preparation of *anti-diphtheritic serums* by which a pure concentrated anti-toxin para globulin has been separated from the blood serum of a horse; the purification of *gelatine*, now being tested for photographic purposes, and finally the *dewatering of oils*, an application largely used on the Californian oilfields.

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

31,490. "Electro-magnetic engine or motors." H. F. Mordey. November 8th.
31,516. "Electric transformers." Metropolitan-Vickers Electrical Co. November 8th. (United States, December 10th, 1919.)
31,517. "Electric speed regulator systems." Metropolitan-Vickers Electrical Co. November 8th. (United States, November 6th, 1919.)
31,528. "Protective devices for electric distribution systems." British Thomson-Houston Co. and H. Pearce. November 8th.
31,529. "Electric indicating and measuring instruments." British Thomson-Houston Co. and R. C. Clinker. November 8th.
31,536. "Electric reactors." S. R. Bergman. November 8th. (United States, June 25th.)
31,576. "Electric lamps for miners, &c." T. Stretton and Thor Electric Safety Lamp Co. November 8th.
31,578. "Apparatus for supply of electric current." J. Balsera. November 8th.
31,586. "Power installations." C. H. Merz and Merz & McLellan. November 8th.
31,588. "Electrical alarm apparatus." J. A. Slee. November 8th.
31,616. "Treating material by a rising fluid current." H. Velten. November 9th. (Germany, December 12th, 1919.)
31,617. "Magneto-electric ignition machines." R. Bosch Akt. Ges. November 9th. (Germany, April 24th.)
31,618. "Magneto-electric, &c., machines." R. Bosch Akt. Ges. November 9th. (Germany, April 22nd.)
31,632. "Flanged system of electric conduit." F. T. Sloman. November 9th.
31,641. "New material, utilisation of electrical properties thereof, and process of manufacturing same." Automatic Telephone Manufacturing Co. November 9th.
31,644. "Electric light switch." S. Morrison. November 9th.
31,660. "Electrical advertising sign." F. W. Bundy. November 9th.
31,665. "Telegraphic tell-tale instruments." A. C. Macneur (Rae) and H. L. Rae. November 9th.
31,676. "System of electric power transmission." British Thomson-Houston Co. (General Electric Co.) and General Electric Co. November 9th.
31,681. "Stud for electrically welding to bulkheads, &c." A. E. Frankling. November 9th.
31,687. "Electric switches." J. Hall & Co. and G. F. Ostins. November 9th.
31,706. "Means for supply of electric current to railway, &c., vehicles from trucks." W. T. Jones. November 9th.
31,711. "Electrical igniters." C. Payne and J. Wild. November 9th.
31,730. "Collectors for electric tramway and railway vehicles." A. C. Baker, H. Cross, and H. M. Dudgeon. November 10th.
31,734. "Transmitting by telegraphy photos, pictures, &c." H. S. Berry. November 10th.
31,749. "Electric lamp fittings." E. P. Austin. November 10th.
31,763. "Device for preventing fires by electricity." T. V. Draycott. November 10th.
31,771. "Sparking plug." J. R. Feltham and H. S. Riches. November 10th.
31,804. "Manufacture of electrical resistance material." Soc. Anon Kummler & Matter. November 10th. (Switzerland, November 10th, 1919.)
31,809. "Electric current transformers." British Thomson-Houston Co. and H. S. Holbrook. November 10th.
31,833. "Loose handle electric circuit breakers, current limiters, switches, &c." R. Amberton and E. N. Bray. November 10th.
31,869. "Dynamo-electric machines." R. Bosch Akt. Ges. November 11th. (Germany, June 18th.)
31,870. "Treating material by a rising fluid current." H. Velten. November 11th. (Germany, February 18th.)
31,891. "Miners' electric safety lamps." J. Davis & Son and G. Dearle. November 11th.
31,908. "Electrodes or plates for electric accumulaors." W. N. Stewart. November 11th.
31,910. "Rotary telephone number indicator." A. W. Weston. November 11th.
31,929. "Electric current transformers." British Thomson-Houston Co., R. C. Clinker and H. S. Holbrook. November 11th.
31,935. "Electro-magnetic clocks." M. P. Favre-Bulle. November 11th.
31,936. "Frames for electro-magnetic clocks." M. P. Favre-Bulle. November 11th.
31,943. "Non-arcing commutating switch." Electric Tool Manufacturnig Co. and H. Fairbrother (Electric Tool Manufacturing Co.). November 11th.
31,956. "Electrical cooking, &c., apparatus." B. C. Garman. November 11th.
31,964. "Electric insulators." Buckman & Pritchard and H. Wade (Buckman & Pritchard). November 11th.
31,991. "Rotor conductors in squirrel cage electric motors." G. E. Moore. November 12th.
32,014. "Electric light installation for alternating current." Naamlooze Vennootschap Philips' Gloeilampen-fabbrieken. November 12th. (Holland, December 5th, 1919.)
32,034. "Secondary battery plates or electrodes." Chloride Electrical Storage Co. (Smith) and E. W. Smith. November 12th.
32,039. "Electrolytic apparatus for preparing hypochlorite solutions." A. T. Masterman and D. M. Rogers. November 12th.
32,062. "Filter for preventing injurious effects of diffusion in galvanic batteries." F. Bormann and H. J. Glanzer (Bormann). November 12th.
32,603. "Batteries with compound electrodes." F. Bormann and H. J. Glanzer (Bormann). November 12th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1916.

3,294. "Electric incandescent arc devices." British Thomson-Houston Co. (General Electric Co.). March 4th, 1916. (152,694.)

1918.

57. "Cooking stoves heated by electricity." R. Arno. January 2nd, 1918. (152,696.)
478. "Transformation of three-phase into practically constant direct currents." O. M. Corbino. January 8th, 1916. (112,938.)

1919.

10,217. "Methods of and means for reducing the lagging current on alternating current systems supplying induction motors and the like." H. A. L. Barry. April 24th, 1919. (152,703.)
13,488. "Electrical signalling lamp." W. T. Coulson and Optalyte, Ltd. November 28th, 1919. (152,707.)
14,008. "Shade carriers for electric lamp holders." V. Hope. June 10th, 1919. (152,709.)
14,614. "Electric lamp holders." V. Hope. June 10th, 1919. (152,710.)
15,344. "Repair or renewal of electric incandescent lamps." F. Harrison. June 18th, 1919. (152,716.)
17,195. "Electric light fittings." British Thomson-Houston Co. and H. C. Wheat. July 9th, 1919. (152,727.)
17,210. "Searchlight and other projectors." Sir C. A. Parsons, E. Bennett, and H. Rowe. July 9th, 1919. (152,728.)
17,516. "Electrodes for electric welding, cutting, reducing, or like operations." C. J. Holslag. July 12th, 1919. (152,733.)
17,686. "Manufacture of metallic filaments." British Thomson-Houston Co. (General Electric Co.). July 15th, 1919. (152,738.)
17,790. "Impulse transmitting devices for use in connection with automatic or semi-automatic telephone systems." Automatic Telephone Manufacturing Co. September 13th, 1918. (152,495.)
17,869. "Telephone and the like systems and loading coils therefor." W. P. Thompson (Compagnie Générale de Radiotélégraphie). July 17th, 1919. (152,745.)
17,973. "Radio-navigational apparatus and the like." J. Erskine-Murray. July 18th, 1919. (152,758.)
17,987. "X-ray tube shields." British Thomson-Houston Co. (General Electric Co.). July 18th, 1919. (152,759.)
18,034. "Telephone transmitter." J. S. Timmons. July 18th, 1919. (152,761.)
18,248. "Telephone systems." C. R. H. Arntzenius. August 19th, 1918. (131,583.)
18,254. "Electric signs." F. A. Smith. July 22nd, 1919. (152,781.)
18,435. "Electric condensers." Dubilier Condenser Co. August 1st, 1918. (130,595.)
18,437. "Electric condensers." Dubilier Condenser Co. March 7th, 1919. (140,045.)
18,438. "High potential electric condensers." Lubilier Condenser Co. March 7th, 1919. (140,046.)
18,492. "Negative and positive resistance vacuum tube devices especially for use in wireless telegraphy." J. Scott-Taggart. July 25th, 1919. (Cognate application 22,960/19.) (152,693.)
19,479. "Modulating and transmitting systems for electric signalling." Western Electric Co. (Western Electric Co.). August 7th, 1919. (152,811.)
19,895. "Galvanic batteries." G. Fuller, L. Fuller, and G. J. A. Fuller. August 13th, 1919. (152,818.)
26,348. "Electric water heaters." W. F. Cutler. October 27th, 1919. (152,868.)
27,085. "Electric bells." J. C. Wrighton and Edison Swan Electric Co. November 4th, 1919. (152,873.)
27,566. "Current collecting shoes for train control systems." H. Haddan (J. B. Regan). November 7th, 1919. (152,875.)
28,762. "Electric dry cells." Burgess Battery Co. November 19th, 1918. (135,502.)
28,845. "Electrolytic apparatus." A. E. Ashcroft. July 9th, 1919. (Divided Application on 152,402.) (152,879.)
30,270. "Switches for electric installations." A. Graf. May 16th, 1919. (143,492.)
31,057. "Sparking plugs for internal combustion engines which can be attached and detached without the aid of tools." S. E. Taylor, F. O. Ellis, and G. E. T. Archer. December 11th, 1919. (Cognate application 4,812/20.) (152,889.)
31,780. "Controlling electro-mechanical power sets for propelling vehicles and ships." Maschinenfabrik Oerlikon. November 3rd, 1919. (152,896.)
32,782. "Feeding attachments for electrolytic cells." I. H. Levin. December 31st, 1919. (152,901.)

1920.

811. "Electric furnaces." H. Wade (Booth Electric Furnace Co.). January 9th, 1920. (152,904.)
2,398. "Sparking plugs for internal combustion engines." H. E. Holloway. January 26th, 1920. (152,909.)
4,396. "Wireless telegraph receivers." L. B. Turner. February 13th, 1920. (152,915.)
5,051. "Intercommunicating telephone systems." L. C. Bygrave. July 22nd, 1919. (Divided application on 140,561.) (152,917.)
6,091. "Heat and measuring appliance for electrical purposes." Siemens-Schuckertwerke. September 12th, 1916. (139,522.)
6,800. "Sparking plugs for internal combustion motors." V. Bonde. December 20th, 1917. (139,816.)
7,544. "Electric starting and regulating switches." C. J. Margerison and F. J. Shenton & Co. March 13th, 1920. (152,926.)
8,657. "Amplifying systems comprising thermionic devices." Western Electric Co. March 28th, 1919. (141,033.)
14,995. "Electric signalling systems." Western Electric Co. September 20th, 1918. (144,293.)
17,239. "Distributing and draw-in boxes for electrical installations." A. Bakker and Bureau Voor Uitvinders. July 17th, 1919. (Divided application on 134,195. Addition to 134,195.) (152,942.)
18,013. "Apparatus for electro-magnetically extinguishing the arc which is produced on the breaking of an electrical circuit." F. Krupp Akt. Ges. June 11th, 1919. (145,715.)
19,527. "Electro-magnetic chucking device." F. Krupp Akt. Ges. June 23rd, 1919. (147,590.)